THURSDAY, JUNE 21, 1894.

THE BROTHERS WILLIAM AND JOHN HUNTER.

Two Great Scotsmen: the Brothers William and John Hunter. By George E. Mather, M.D., F.F.P. and S. (Glasgow: James Maclehose and Sons, 1893.)

IF too long a time may seem to have passed away before we review this handsomely illustrated volume, we excuse ourselves by saying that before we determined to undertake the task we would read the work through conscientiously and thoughtfully from its alpha to its omega, and compare it with the sources of information from which it is compiled. We saw by the general tone of the press that the volume was being rather roughly treated, and hoped that some prejudice or carelessness had been at work, which might be corrected. It too often happens that treatises on science and on the labours and works of men of science are merely glanced at and spoken of from hastily gathered impressions bearing mainly on style and manner, not on actual matter of fact relating to the work and the mind that produced them. It happens also, not unfrequently, that in a work, difficult of comprehension at its first reading, one or two reviews set the tone for praise or dispraise to all others; so that a good work may, as it were, be, by accident, doomed to light or to darkness without just cause.

Let us say first then of this volume that as a work it is admirably got up and illustrated. The plates, whether they relate to men, buildings, or scenery, are simply perfect, and the volume altogether is just such an one as every scholar would be tempted to take down from the shelves and read at leisure. Let us say further, that through the narrative the author balances fairly between the two brothers, William and John Hunter. He discriminates wisely in regard to their characters, and shows how largely John Hunter was dependent for his success on his elder brother. But in his descriptions he has, too often, adduced sayings and thoughts which he has gathered from reading, and, with little alteration, has transferred to his own pages as if they were his own property. Thus, in comparing the two brothers, he makes use of a paragraph with which the life of William Hunter, by another author, is brought, in capital type, to a close.

"The brothers Hunter were twins in science, and William was the first-born."

A sentence which reads as follows, speaking also of the two brothers.

"Verily they were twin stars of the first magnitude, and William was the elder-born."

Such variations as these give to the volume the character of a compilation rather than a history, the whole appearing tinged also with a sense of weariness, as if its author were endeavouring to make old matter appear new, only too anxious to fill up his pages. To this must be added the introduction of matters almost altogether irrelevant. For example, at pages 40, 41, 42, we find a discussion, or colloquy, between Thomas Carlyle and Edmund Irving, with a long quotation from Carlyle, interesting enough in itself, but having not the slightest reference to the subject in hand. In like manner there is dragged in, at page 46, a description of the Manse at Mearns, where Christopher North received his early education, with a somewhat similar diversion on North Moorhouse, where Robert Pollok, the author of "The Course of Time," was born, together with a specimen of the poetry of the same poet, and a final digression containing snatches from the Ettrick Shepherd, Joanna Baillie, Prof. Wilson, and a rather long account of the famous Dr. Cullen, who, although a kind of master of William Hunter in his early life, is so much in evidence here, as to be made subject-matter for a third short biography, rather an intrusion when so much more admitted of being spoken of in reference to the two particular heroes of the book.

In noticing the labours of William Hunter, Dr. Mather is most at home in his description of the Hunterian Museum in Glasgow. With this palace of science he is evidently well acquainted. He remembers it in its old days, when it rose like an ancient temple in the grounds of that memorable old college which is now a railway station, and he knows it as it now stands, a part of the splendid new college which, as he says, "crowns the heights of Gilmorehill." The museum, he tells us, was begun for the purpose of illustrating the lectures of William Hunter, and at first its chief value consisted in the preparations showing the changes of the gravid uterus. "The Museum was not, however, confined," as he very properly explains, "to anatomical preparations, human and comparative, nor to specimens of disease merely, although the collection of these was wonderful, and thanks to hints from Albinus, all are in beautiful preservation. "Dr. Hunter was a man of very refined taste, and had a great desire to educate the members of his own profession, as well as the public, in this respect, and to afford opportunity to all of acquiring a rich and varied culture. William Hunter was a great teacher, and it was his ambition that his works, his bequests, should live and speak after him; it is not too much to say that there never has been gathered under one roof by one man a collection so vast and varied, and so well calculated to advance the wider culture of the members of the profession whose interests he had so greatly at heart." And then he adds, copying word for word from a previous author, whom he immediately names, but not in connection with the passage: "Whether we turn to the Art Department, to the books, to the coins, to the natural history, or to the anatomy, there is to be discovered treasure upon treasure."

In the life and works of John Hunter presented in this volume, we find the same kind of faults as those which mark the life of William Hunter. There is compilation simply as the basis of all that is written, intermixed with a kind of philosophy which is also often the reflex of previous authorities, with more or less of acknowledgments. Much that might have been introduced and descanted upon is omitted, or so lightly touched as neither to be criticism nor narrative. Thus the great quarrel between the two brothers, which kept them practically apart for a long period, receives no new elucidation, and the life of John Hunter, at Earl's

Court, in the house recently pulled down and replaced by so many houses and streets that its site is now lost, receives the most scanty attention. Here, too, illustration fails us, which is much to be pitied, because illustration in the former part of the book has afforded its chief value.

There is nothing more painful to a reviewer than to find himself forced to discover faults and deficiencies in a work under his observation, and we have felt severely the task of pointing out the defects and deficiencies of the volume before us. But it would be false, even to the author of the work, if we did not notice its failures, for there is evidently an ardent desire on his part to be not only a faithful, but an enthusiastic biographer. What is wanted in his essay is work! work! work! expurgation of all that is irrelevant, introduction of all that can be added beyond what has been told by predecessors on the subject, with avoidance of the pitfalls of mere memory.

In a new edition, if it should appear, we will hope that the improvements suggested, in a perfectly friendly spirit, will be carried out. The volume as it now stands is a groundwork of a good treatise, which, under the influence of industry, learning, spontaneity, and art, might yet secure a good place in the literature of the century.

GOLD.

The Metallurgy of Gold. By T. Kirke Rose, B.Sc. (London: Charles Griffin and Co., 1894.)

A Hand-book of Gold Milling. By Henry Louis. (London and New York: Macmillan and Co., 1894.)

THESE two books, which have been issued almost simultaneously, constitute important additions to the metallurgy of gold. They are both written by Associates of the Royal School of Mines, and it is singular that although the students of this great national institution have taken their full share in conducting mining and metallurgical operations in all parts of the world, and have gained wide experience, no treatise claiming to give a general account of the metallurgy of gold could hitherto have been attributed to a student of the School of Mines. No work on this subject of equal importance has appeared in English since Dr. Percy issued his volume on "Silver and Gold," in 1880, but his book, although unrivalled in accuracy of detail, is only a splendid fragment, and gold is alone dealt with in the sections devoted to the refining of bullion and to assaying.

Mr. Rose, who it appears gained his experience of gold and silver extraction in the Western States of America, is one of the able band of young men of whom Prof. Roberts-Austen is forming, in this country, a new school of metallurgists which is doing so much physical work in connection with metals and alloys. In the present volume Mr. Rose has made a successful effort to supply a succinct summary of the existing conditions of the metallurgy of gold for the use of students and others who are interested in the industries connected with the precious metals. In the second volome under review, Mr. Louis turns, it is true, more directly to an industrial application of the metallurgy of gold, and addresses the mill-man rather than the student; but Mr. Rose's volume is far from being only a student's manual, as he keeps steadily in view the needs of the managers of the gold mine and smelting works, a class who have hitherto considered that they had "little to learn from books."

The whole of the ground indicated by the title "metallurgy of gold" has been covered by Mr. Rose with equal care, and the space is carefully apportioned to the various branches of the subject according to their relative importance. Mr. Rose is probably at his best in dealing with the chemistry of the subject, as, for instance, in describing the MacArthur-Forrest process, which is now, for the first time, fully dealt with in a manual. Its importance may be gathered from the fact that nearly one-tenth of the world's annual production of gold is now being extracted by its aid. Among other processes which have not hitherto been described in a book, three deserve special mention. These are the process for separating gold from silver by the new Gutzkow process; the electrolytic process; and the modern barrel chlorination process, which is practised with great success in Dakota, where the Black Hills district is being rapidly developed by its aid. These processes are of special interest, but none which have stood the test of experience have been omitted. The four chapters devoted to chlorination, written from the point of view alike of the practical man and the chemist, teem with considerations hitherto unrecognised, and constitute an addition to the literature of metallurgy, which will prove to be of classical value.

The author has evidently taken great pains to secure details of gold-working from all parts of the world, and his descriptions range from Colorado to New Zealand and thence to South Africa, and as a result he has furnished practical men with details of working which should be of much service to them.

No less than eleven pages are devoted to an elaborate bibliography that is certainly more complete than any earlier ones, the latest of which—in Lock's work on the occurrence of gold—only brought us to the year 1882.

The illustrations are simple but effective; they are sufficiently accurate, and are characterised by much freshness, there being no time-honoured diagrams from other metallurgical manuals. The same may be said of the illustrations in Mr. Louis' work.

Mr. Louis, in his book on "Gold Milling," has mainly limited his attention to the treatment of gold ores in stamp mills, and has, as the result of much personal experience, written a treatise of great practical value. He gives details of machinery with great fidelity, as a worthy pupil of the late Dr. Percy would be sure to do. While Mr. Louis clearly sets forth the general methods of working adopted in stamp mills, he reserves for full description those which he considers to be the best, instead of giving details of all methods, good, bad, and indifferent, that are to be met with in various parts of the world.

In a future edition the author would do well to devote additional space to considerations relating to the mill site, its building, modes of construction, and installation of machinery. These are of more importance to the mill manager, for whom the work is intended, than the shape of the cam-curve, and other points to which the maker of machinery should attend. The experience gained in the South African gold-fields, where the number of stamps at work is greater than in any other country, has

led to great developments of practice, which it would be well to consider when the time comes for revising the work. If, however, the book be considered as a whole, Mr. Louis has undoubtedly offered the best account of gold milling that has yet appeared.

In concluding this review of both books, it may be well to remind the reader that, of all the phases of metallurgic art, that which leads to the consideration of gold is the most interesting. It is certain that modern chemistry had its dawn in the study of the properties of gold, while from the fourth to the fifteenth century chemists thought of little else than transmuting base metals into precious ones. The protest of the metallurgist against such wasted labour was, however, felt as early as the middle of the sixteenth century, and a book, "Rechter Gebrauch d'Alchemei," was published (1531), which by its title showed that the "right use of alchemy" was to bring chemical knowledge to bear upon industry. Hence it is that the modern metallurgist makes strenuous efforts not to transmute base metals into gold, but to extract it economically from a mass of material of which fifteen million parts may only contain one part of gold. It would be most interesting to know at what cost this is done, but upon this point Mr. Rose is unable to give us very definite information, though it is evident he considers that the ounce of fine gold which sells for about £4, should be produced for about £3, if it is to yield a profit to the miner and metallurgist.

Both books under review have each their special value. Mr. Rose has adopted a broad treatment of a very interesting subject, while Mr. Louis has shown how important a single branch of the metallurgy of gold can be.

OUR BOOK SHELF.

Geology. By Charles Bird, B.A., F.G.S. Pp. viii., 430. (London: Longmans, Green, and Co., 1894.)

LIKE the previous volumes in the series of Advanced Science Manuals published by Messrs. Longmans, this satisfies the requirements of the advanced stage of the Department of Science and Art. A sub-title informs us that the book is "a manual for students in advanced classes and for general readers." But while we believe the work to be well suited for use among students learning geology on South Kensington lines, we should be sorry to recommend it to the general reader, that is to say, to the person who reads geology for the pleasure it affords, and not with the idea of eventually exercising the acquired knowledge in an examination room. The author has collected together an abundance of facts, but the student who has to digest them all deserves our sympathy. There are, however, several good points about the book. One of these is the chapter on the industrial uses of rocks, in which numerous buildings, monuments, and other structures in London and elsewhere are noted as examples of various kinds of building materials. References to the practical application of geology to water supply, agriculture, and mining are also frequently made, and will doubtless endear the book to the man who measures the value of a science by its direct use in commercial life.

Mr. Bird has taken advantage of the splendid collection of photographs of geological formations published by Messrs. Wilson, of Aberdeen. The illustrations obtained from this source are among the best in the book, and many of them have not previously appeared in any work on geology or physiography. Another excellent feature in the pictorial part of the book is that a number of the figures of fossils, rocks, and minerals are from photographs of objects in the Jermyn Street Museum. The illustrations of some of the minerals are, however, not very instructive. The only use of a figure is to assist the student to distinguish the characteristics described in the text. It is doubtful, however, whether the figures of hornblende, heavy spar, fluor spar, iron pyrites, galena, and sulphur, given on pp. 24-30, are any help to identification, though one or two of them may serve to illustrate crystalline habit.

Scarcely any attention is paid to the microscopical examination of rocks, and we have vainly consulted the index for references to the use of the seismograph, earth-tremors, the permanence of ocean basins, secular movements of the sea, and several other subjects of recent work. Even if these matters are not specially mentioned in the syllabus which the book has been designed to meet, they might have been included with advantage. We note that Eozoon is still referred to as "the most ancient fossil known," though its mineral formation has been clearly made out. But taken altogether the book is trustworthy, and the student who assimilates its contents need not fear to present himself for the examination in Advanced Geology held by the Department of Science and Art.

The New Technical Educator. Vol. III. (London, Paris, and Melbourne: Cassell and Company, 1894.)

THE previous volumes of this series have been duly noticed in these columns, where it was pointed out that they very adequately fulfilled a useful purpose. The present volume is up to the level of its predecessors, treating as it does of every-day general engineering and other matters in their broadest sense. The information given is certainly of very recent date, and this is as it should be, from every point of view. There are, however, a few statements made that are not quite accurate; for instance, on p. 102 we are told that among other things wrought iron is supplied commercially in the form of rails. What railways now-a-days use iron rails? They are things of the past, steel having years ago taken their place. Further on we read that steel plates may now be obtained up to 70 square feet in area. Surely double this area would be nearer the mark? On page 105 we are told that fullering a rivetted joint means to caulk it with a narrow edge tool (as at C, Fig. 3). This is certainly not the case; to fuller a joint means to "set up" the plate edge with a tool at least the thickness of the plate, whereas the method shown in the figure is generally known as "narrow edge caulking." Further on it is stated that looseness at the rivets is sometimes guarded against by caulking the rivet-heads. This is all very well, but loose rivets should be cut out and replaced by sound ones.

Under the heading of "various types of steam boilers" we find much useful information, the locomotive type being represented by the standard boiler used on the Lancashire and Yorkshire Railway; it is, however, stated that in some cases the water spaces are carried down and across the bottom, thus constituting an ash-pan and called a wet bottom. This no doubt is true of a few boilers built at Crewe, but in the majority of cases the wet bottom is unknown to modern railway practice. In this chapter George Stephenson is said to have introduced the blast pipe in locomotives. Surely this invention is due to Richard Trevithick?

The marine type of boiler is represented by one made by the Central Marine Engine Company, West Hartlepool; it is of the single-ended type, and fitted with Fox's corrugated flues. Of water tube boilers there are two standard examples, viz. the Babcock and Wilcox for stationary engines, and the Thorneycroft for marine and

other purposes. Considering the present rage for this type of boiler, other examples might have been given with advantage.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Hodgkins Fund Prizes.

THE time within which papers may be submitted to competition for the Hodgkins Fund Prizes of the Smithsonian Institution, for essays in regard to the nature or properties of atmospheric air, has been extended from July 1 to December 31, 1894. This action has been taken for the reason that many of the circulars announcing these prizes seem to have failed to reach the persons for whom they were intended.

Numerous inquiries have been received, which render it desirable to announce that while it is preferred that the name and address of each competitor should be attached to the manuscript, any one who desires it, is permitted to send his name and address in such a form that they can be detached from the manuscript, which he may identify by means of a motto. The manuscripts of unsuccessful competitors will be returned wherever they have been accompanied with the proper address; but the proprietorship of papers which have been awarded one of the named prizes, will rest with the Institution, which only desires to give them a wide publicity; and no copyright privileges are, in this case, to be expected by the author.

Papers which have been already published will not be accepted in competition for the prizes, but may be eligible for the medal. This medal will be awarded in the same way that medals are usually awarded by the principal scientific societies, the medallists being chosen from all investigators known to the Committee of Award, and not necessarily from among those who have submitted papers.

Information regarding the Hodgkins Prizes and the Smithsonian Institution may be obtained from the Secretary of the Institution, S. P. Langley, Washington, D.C., or from the Agents of the Institution, Messrs. William Wesley and Son, 28 Essex Street, Strand, London. S. P. LANGLEY.

Washington, June 6.

Electrical Theory of Vision.

IN reference to the hypothesis concerning vision which I suggested at the Royal Institution on June 1, Dr. Obach has favoured me with the enclosed letter detailing an observation of his on his own eyes, which may be worth placing on record. I therefore send it on to you. OLIVER J. LODGE.

University College, Liverpool.

IN your very interesting discourse at the Royal Institution on Hertz's work, which is reproduced in NATURE of June 7, you suggested that the susceptibility of the eye to light-waves might be analogous to that of your "coherer" to Hertzian waves, and that the light merely causes a diminution of electric resistance of some badly-conducting material interposed between a source of electricity and the sensitive nerves of the eye. The sensation of darkness you explain by the return of the interposed body to its original state, produced by an automatic tapping back on the part of the tissues.

In reference to this matter, I should like to bring to your notice an observation, made some three years ago, which seems to me to support your views as to the *modus operandi* of the eye. One evening, after having watched the famous Rhine Falls, near Schaffhausen, for a considerable time in the full glare of the sun, which produced a dazzling whiteness of the spray, I felt intense pains in the head and eyes, which did not diminish much even after I retired to bed in a perfectly dark room. I thereupon resorted to a remedy, which had given me relief on previous occasions with pains in the eyes caused by overstrain, *i.e.*, I placed the thumb and forefinger on the eyes over the closed eye-lids and imparted gentle vibrations to the eye-balls. After two or three vibrations I was compelled to stop, as the remedy was not only very painful, but also produced the sensation of a bluish-white light of dazzling brightness (like an electric arc) being brought almost into contact with the eyes. After the lapse of a few minutes the luminous phenomenon subsided, and I again commenced the vibrations of the eye-balls, which now I could do a little longer than before ere it became unbearable. This operation I repeated, with intervals of rest, perhaps eight or ten times, till finally the vibrations were almost painless and produced no longer any luminosity; the pains in the eyes and head had then nearly disappeared, and I slept soundly the whole of the night.

The explanation of this curious observation seems to me the following:—The intense brightness of the light reflected from the spray had not only reduced the resistance of the intercepting medium to a minimum, but at the same time overtaxed the elastic tissues whose duty it would have been to shake the material back into its normal condition, after the cessation of the light. The energy thus lost by the tissues was then suppressed from without by the vibrating fingers.

For what reason the return of the intercepting substance to its original insulating condition should also be attended by the sensation of light is difficult to conjecture, unless it be directly due to the physiological effect produced on breaking the circuit.

Similar effects, only not so pronounced, can be observed on vibrating the eye-balls after any ordinary overstrain of the eyes.

Old Charlton, Kent, June 10. E. OBACH.

Ophiophagus.

THE family of the venomous snakes called Elapidæ is divided into two sections, the Najidæ, or snakes with hoods, and the Elapidæ, without hoods. The Najidæ is represented by the Cobras and Ophiophagus; it has two genera, Naja and Ophiophagus.

The genus Ophiophagus has but one species, the *Ophiophagus elaps*, or *Hamadrayas ophiophagus*. This is probably the largest and most formidable venomous snake known. In size and deadliness it rivals the Crotaline snake, *Lachesis mutus*, the Bushmaster, found in South America. The Ophiophagus grows to the length of 12 or 14 feet, or even more. It is hooded like the cobra, and resembles it in configuration and character. The colour varies according to age and locality, being some shade of olive-green or brown; young specimens have a different colouring, and might easily be mistaken for another genus.

This deadly snake, though widely distributed, is fortunately not very common, and consequently its bite, though fatal, does not contribute largely to the 20,000 deaths that occur annually from snake-bite in India. It is found on the Indian Continent and Burmah, in the Andaman and Philippine Islands, in Java, Sumatra, Borneo, and perhaps in New Guinea. It is not known much, if at all, in North-Western and Central India; it is more common in the damp climates of Bengal, Burmah, Assam, and Southern India.

The Ophiophagus, like other snakes, takes readily to the water. It is found in the forest and grass jungle and in hollow trees; it climbs readily, being frequently found in the branches. As its name implies, it feeds upon other snakes, but probably, when its usual food is not forthcoming, it will take small mammals, birds, fish, or frogs.

It resembles the cobra, except that it is longer in proportion to its size, and that the hood is relatively narrower. The poison is of a golden yellow colour. It is even more graceful in its movements than the cobra, and turns more rapidly. The snake-charmers in India prize it highly, but they say it is exceedingly dangerous to catch and difficult to handle before its fangs are removed. It is said by the Rev. Dr. Mason, who knew it in Burmah, to be very aggressive, and Cantor describes it as being very fierce, and ready, not only to attack, but to pursue when opposed. Its Bengali name is Sunkerchor.

Three remarkably fine specimens of this rare snake have been received at the Zoological Society's Gardens. A few years ago a specimen died, which had lived for a long time in the Gardens and excited great interest. That and the individuals under notice are probably the only specimens that have been brought alive to this country.

It will be of interest to numbers of naturalists and others to know that this rare snake is now alive in the Society's Gardens, Regent's Park, where it can be seen to great advantage in the large and well arranged reptile-house. J. FAYRER.

London, June 12.

Mohl's "Primordial Utricle."

I SHOULD like to inquire, through the medium of NATURE, whether the way in which botanists now use Mohl's term "primordial utricle" is strictly accurate? In Sachs' "Lehrbuch," and in the English translation, it is applied to the *parietal layer of protoplasm* found in plant cells which are old enough to have a large central vacuole, and this practice is now generally followed by English botanists.

Now, in Henfrey's translation of Mohl's "Principles of the Anatomy and Physiology of the Vegetable Cell," it appears to be used in a different sense. On pp. 36–37 we have a description of *the young cells* of plants, in which the "primordial utricle" is spoken of as "a *very thin granular membrane*," which by appropriate methods becomes "*detached from the inside of the wall*," . . . "and consequently removes all the contents of the cell, *which are enclosed in this vesicle*, from the wall of the cell." (The italics are mine.) After this Mohl briefly refers to the nucleus, and then goes on to say that "the remainder of the cell is more or less densely filled with an opake, viscid fluid of a white colour, having granules intermingled with it, which fluid I call protoplasm."

Thus even in *young cells*, Mohl recognises not only the protoplasm and the nucleus, but a "primordial utricle" also, and save that he says it is granular, one might take it as the equivalent of what we now speak of as the ectoplasm.

Proceeding with his description, Mohl describes, on p. 38, how as plant cells become older, a large vacuole is gradually formed in the interior of the protoplasm, which then becomes differently distributed. In the result he tells us, "the protoplasm is then accumulated at one side in the vicinity of the nucleus; on the other side *it coats the inside of the primordial utricle*." (Italics again mine.)

Thus in the older cells, as well as the younger, we have a clear distinction drawn between the protoplasm and the "primordial utricle," a distinction which recent writers seem to ignore.

It is possible, though scarcely likely, I think, that Henfrey has not faithfully reproduced Mohl's conception of the "primordial utricle," or it may be that my interpretation of the above passages is at fault. In any case, it would be an advantage to have the opinions of our leading botanists on this point, as it is one which, to my own knowledge, brings some perplexity to students.

THOMAS HICK.

Owens College, June 14.

Hailstones at Cleveland, Ohio.

A REMARKABLE hailstorm occurred at Cleveland, Ohio, on the afternoon of Thursday, May 17, of a character to be remembered but probably not repeated during the present generation. Larger hailstones are rarely seen than fell on that day, and very likely few, if any, people living in this part of the country have ever witnessed a more severe bombardment.

The air was intensely sultry up to twenty-eight minutes past three o'clock in the afternoon (sun-time), when it commenced to rain. Hailstones of moderate size rattled down in profusion, and it soon appeared that an ordinary thunderstorm had begun. At the east end of the city the wind increased rapidly in force, and it grew very dark. Presently the hail became violent, and for about twenty minutes the streets and lawns presented a most animated appearance. The impact of the icy bullets against the roofs of houses sounded like the rattle of musketry. The snow-white balls glistened upon the close-cropped lawns, where they kept up a lively dance, and in the street were shattered against the flags and paving stones.

The stones, many of which were as large as billiard balls, and some of the size of goose eggs, weighed from one to five or six ounces, and probably many that fell were much heavier than this. Their shape was very various, some being spheroidal, others discoidal or exceedingly irregular. The accompanying figures represent to some extent the forms of two stones which fell on the Adelbert College lawn, and were picked up by some of our students.

A hailstone was found by Prof. F. P. Whitman to weigh nearly an ounce and a half after it had melted considerably. Its measurements were $2\frac{3}{4} \times 2\frac{1}{2} \times 1\frac{1}{4}$ inches. The surface was fissured and raised into tubercles, while many others had an exaggerated mulberry appearance, suggesting a composite structure. Sections of such stones showed, however, that they were as a rule formed about a single nucleus, and were not the result of the regelation of a number of separate pellets.

The specimen represented in Fig. 1 measured three inches in length, two in breadth, and about one in thickness. There were two opaque central masses, the larger of which contained the original nucleus, while the smaller spot probably represents a stone which became welded to the larger and older one.

A somewhat flattened, or discoidal form, which was very common, presented a beautiful agate-like core, embedded in a clear mass. A section of one of the stones, which was sawn in two, is shown in Fig. 2. There is a central ball of snow-ice,

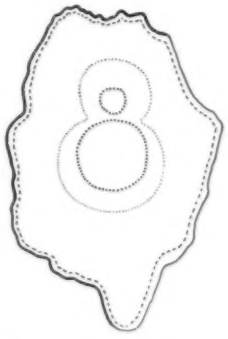

Fig. 1.—Outline of hailstone two-thirds natural size. Dimensions 3×2×1 inch.

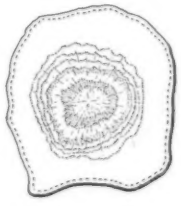

Fig 2.—Section of hailstone, two-thirds natural size.

and this is surrounded by alternating light and dark layers of varying density, and by a very much thicker clear, outer envelope, unshaded in the drawing, showing that the stone had passed through at least two distinct regions of condensation. There were also usually one or two thin superficial strata.

A stone which was examined by one of the observers at the United States Signal Office, was $3\frac{1}{2}$ inches long, 3 inches wide, 2 inches thick, and measured $10\frac{1}{2}$ inches in circumference. Another, which fell near Board of Education Building on Euclid Avenue, was weighed and measured by Principal Theo. H. Johnston. It was oval in shape and measured 3×2·5×2·75 inches, and weighed, after some melting, $4\frac{1}{2}$ ounces. The surface of this stone was deeply pitted as by impact of warm raindrops. A second, brought in by one of Mr. Johnston's pupils, weighed 5·5 ounces. It had a large pear-shaped snow-iced centre.

The hailstorm was restricted to a belt a few miles in length, and formed a part of a general westerly storm, which was felt in this region for four or five days. During the thunder and hailstorm of May 17, the air-pressure remained nearly constant, the temperature fell from 84° to about 64° F. At the beginning of the storm the wind was south, and blowing at a rate of ten miles an hour, and increased to a rate of only 24 miles an hour. On the same day a destructive cyclone occurred at Kunkle in the north-western part of the State, in which a number of people lost their lives.

Everything in glass exposed to the brunt of the storm, when not of the strongest kind, was destroyed. Electric light globes, photograph galleries, and greenhouses suffered most. Canvas awnings were riddled. Flowers were cut down, and fruit and shade trees badly injured in many places. Horses and other animals, often too terrified to stir, winced under the stinging shot which they could not avoid. A few cases occurred of persons who were cut or stunned by the falling stones or glass. A man at the Winton Bicycle Factory was struck in the head as he stooped to pick up an unusually large stone, and was brought into the workshop in an unconscious condition. The stone went through his straw hat, and cut into his scalp.

FRANCIS H. HERRICK.

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Finder Circles for Equatorials.

ON p. 64 of the current volume of NATURE, I find a paragraph on "Finder Circles for Equatorials," which demands

notice on my part because it impugns not only the verbal statements made to many astronomers who have inspected the instruments of the U.S. Naval Observatory, but also the correctness of an official report made by me to the Superintendent of the Naval Observatory, and appended by him to his report for the year 1893, printed copies of which have been distributed to nearly all the observatories in the world.

The paragraph in question is based upon an illustrated article in the *Zeitschrift für Instrumentenkunde*, 1894, 14 Jahrgang, pp. 128–130, which purports to be a description of the 12-inch equatorial telescope of the Georgetown College Observatory, and in which it is asserted (1) that the instrument was constructed *nearly three years ago* by Mr. Geo. N. Saegmuller, of Washington, D.C.; (2) that its principal novelty is a pair of star dials, or finding circles; and (3) that similar instruments have been constructed by Mr. Saegmuller for the U.S. Naval Observatory at Washington, and for other institutions which are named. From these statements the writer of the "Astronomical Column" very naturally inferred that Mr. Saegmuller constructed these dials, or finding circles, three years ago, when in reality he did nothing of the kind. The facts are as follows:—The idea of these finding circles first occurred to me while the question of building a 12-inch equatorial mounting for the U.S. Naval Observatory was under consideration, and in the specifications for that instrument, which were dated May 20, 1891, I embodied it in these words: "Connected with them (the quick motions) and arranged so as always to face a person operating them, suitable indicators shall be provided for showing automatically the right ascension and declination of the point to which the telescope is directed." Mr. Saegmuller got the contract for building that mounting, and the details of these indicators were arranged between us. The erection of the mounting at the Naval Observatory was completed in November 1892, and almost immediately thereafter Mr. Saegmuller put an exact copy of its indicators upon the Georgetown College telescope, *which he had erected some time previously*. Finally, the two woodcuts which illustrate the *Zeitschrift's* article are not pictures of the Georgetown College telescope, but of the Naval Observatory telescope, which differs from the Georgetown instrument in many details. WM. HARKNESS.

Washington, D.C., June 7.

On the Use of Quartz Fibres in Telescopes.

PERHAPS it may interest some of your readers to know that the quartz fibres of Prof. Boys affords an excellent material for providing the eye-lens of telescopes, and specially the instruments used in combination with reflecting galvanometers and electrometers, with threads required for their adjustment on the divisions of the scale. I thought at first that as the fibres appear, when examined with the microscope, to be semi-transparent and have a silver-grey colour, they would, when seen behind the ocular lens, not present themselves as distinct and clear lines, but as a matter of fact, when they were put at the proper distance, they showed an intense *black* colour, even darker than the divisions made with ink on the scale on which the instruments were focussed. I used threads of 20 microns diameters, and they can be fixed on the diaphragm without much difficulty by means of a mixture of resin and mastic applied with a heated wire, and this mixture answers better than brittle shellac. It is obvious that the threads, when laid down in the diaphragm, are at once stretched, and remain in good condition, as they are not affected in any appreciable degree by the influence of heat and atmospheric moisture. L. BLEEKRODE.

The Hague, June 18.

Bullet-Proof Shields.

IN reply to a letter on bullet-proof shields, in the last number of NATURE, I wish to state that some preliminary experiments with spheres show that the energy of the shot is transmitted to the spheres nearly in line with the direction of the blow, to such a degree that great damage is done to the board to which the spheres are attached. This is not the case when rods are used. I hope shortly to give the details of my experiments on the subject. FREDERICK J. SMITH.

Oxford, June 16.

THE HORN EXPEDITION FOR THE SCIENTIFIC EXPLORATION OF CENTRAL AUSTRALIA.

INFORMATION has been received of the organization and despatch from Adelaide of a new and well-equipped expedition for the scientific exploration of the Macdonnell Ranges which lie about eleven hundred miles to the northward of that capital and nearly in the centre of the Australian continent. The expense of this expedition is borne by a wealthy and public-spirited colonist of South Australia, Mr. William Austin Horn, who thirty years ago carried out on his own account some explorations in the Gawler Ranges, and has since taken a very active part in the development of the mineral resources of the country, besides being a prominent member of the colonial legislature and of the Council of the University of Adelaide. Mr. Horn himself is the leader of the present Expedition, but has wisely associated with him some scientific gentlemen of great experience in Australian travel. Among them are Mr. Charles Winnecke, of the Trigonometrical Survey of South Australia, who in the performance of his duties has repeatedly traversed some of the most arid country of the continent, and has mapped out some thirty thousand square miles of its surface. With him also goes as medical officer, Dr. E. C. Stirling, C.M.G, F.R.S., of the University of Adelaide, the well-known discoverer, a few years since, of *Notoryctes*, and latterly the investigator of the *Diprotodon*-deposits, the results of which so many are impatiently expecting, though now it is clear that for them they will have to await his return from this new undertaking, the charms of which he found it impossible to resist. Besides these there are of the party, Prof. Ralph Tate, also of the University of Adelaide, and President of the last meeting of the Australasian Association for the Advancement of Science, eminent as a palæontologist, and especially as a palæobotanist, as well as Prof. Baldwin Spencer, whose name, from his connection with Owens College and Oxford, will be at once recognised by all; while there is also Mr. J. Alexander Watt, of the Geological Survey of New South Wales, to pay special attention to mineralogy and petrology. In the capacity of collecting naturalists, Mr. F. W. Belt, of Adelaide, and Mr. G. A. Keartland, of Melbourne, complete the staff of the expedition, which will be accompanied by three camel-drivers, a cook, and two prospectors sent by the Government. The Expedition was to leave Adelaide on May 3rd for Oodnadatta, and thence proceed along the telegraph line as far as Lilia Creek, where it will turn to the westward towards the Ayers Range and Goyder's Springs, after which it will make for the Palmer River, and then, deviating again to the westward towards Petermann Creek, will return to the upper valley of the Finke River, and then push on to Glen Helen at the foot of the Macdonnell Ranges. It will of course be understood that circumstances may cause this plan to be modified more or less extensively; but from the previous experience of those who have laid down the route to be taken it will probably be carried out pretty much as is intended, though some of the country to be traversed is absolutely unexplored, and much of it very imperfectly known. Wherever a prospect of doing work is found, a longer or shorter halt will be made, and as the Expedition is to be well furnished with camels—no fewer than twenty-three being taken with it—the difficulties that attend the needful supply of water will be reduced to a minimum, while it is said that owing to recent good rains in the latitudes to be passed through everything looks promising for a successful journey.

The importance of this undertaking is not easily to be over-rated. Expeditions of one kind or another to the interior of the continent have been numerous, and

productive of results that we should be the last to impugn; but this we believe is the first attempt at a purely scientific investigation of Central Australia, while the names of the distinguished men whom Mr. Horn has been so fortunate as to engage in it, are a guarantee of the serious way in which it will be conducted. We doubt not that he and his companions will find plenty of rough work before them, and possibly some risk; but if good wishes can help them they may rely on those of all our readers, together with their high and hearty appreciation of the spirit which has prompted that gentleman not only to defray the cost of the Expedition, but to put himself at the head of it at a time of life when most men think of retiring upon the fruits of their labours.

THE ENRICHMENT OF COAL-GAS.

IT is almost impossible to over-estimate the importance of the influence which coal-gas has exercised upon the advancement of civilisation during the past fifty years, and at the present time it has reached a phase in its existence upon which its future career and utility is very largely dependent.

Up to the middle of the century but little attention was paid to the quality of the gas supplied for illuminating purposes; the gas manager made the best gas he could with the coals at his disposal, and the consumer was content as long as he obtained a reasonable amount of light.

In 1850 a Bill was passed which enacted that the light emitted by a brass argand burner with 15 holes, consuming five cubic feet of gas per hour, should be equal to the light of 12 wax candles of the size known as "sixes." These wax candles were, however, only equal in illuminating power to 10·3 of the sperm candles at present used for testing purposes. In 1860 an Act changed the illuminating power to 12 sperm candles, and in 1868 this was again raised to 14 candles, and by the Act of 1876 this was increased to 16 candles, and remains so to the present time.

In 1864 the 15-hole brass argand was discarded as a standard testing burner, and was replaced by a 15-hole steatite burner, which by increasing the temperature of the flame developed more light, whilst in 1869 the "London argand" 24-hole burner was introduced, and gave a still further increase in the light obtained from the gas, so that when we speak of London being supplied with 16 candle-power coal-gas, it means that the light emitted by the gas when burning at the rate of 5 cubic feet per hour from a London argand shall be equal to the light of 16 sperm candles of the size known as sixes consuming 120 grains of sperm each per hour.

When we come to consider what this in reality amounts to, we find that by one of those subtle strokes of humour in which our legislative body occasionally indulges, it means to the consumer almost anything except a light equal to 16 candles. The illumination which can be obtained by the consumption of coal-gas is entirely dependent upon the method by which the gas is burned. From a so-called 16-candle coal-gas the consumer rarely obtains a value of more than 12 candles per 5 cubic feet of gas consumed; whilst by using burners of rational construction, upwards of 40-candle illuminating power could be obtained for the same consumption of gas.

The light emitted by a coal-gas flame is dependent upon its temperature, and flat flame burners, exposing a thin sheet of flame to the cooling action of the air, give the worst results. Argand burners are better, as the cooling is not so great, whilst the regenerative burners lately introduced, by utilising the heat of the products of combustion for raising the temperature of the gas and air supplied to the flame, give an enormous increase in the light emitted.

If the gas companies could only get an Act passed authorising the use of the regenerative burner as the standard, there is no reason why they should not call the gas at present supplied 40-candle gas; the consumer, however, using the flat-flame burner would still be only obtaining the same light as at present. Incandescent mantle burners, which act on a totally different principle, also yield a high illuminating value.

On carefully testing the burners in ordinary use we find that for an equal consumption of gas the results at once show the enormous advantage to be obtained by regeneration, and also how serious is the loss which attends the employment of ordinary burners.

Light obtained per cubic foot of 16-candle gas consumed.

Burner.	Candle units.
Regenerative and incandescent	7 to 10·00
Standard argand	3·20
Ordinary ,, ...	2·90
Flat-flame No. 7	2·44
,, ,, 6	2·15
,, ,, 5	1·87
,, ,, 4	1·74
,, ,, 3	1·63
,, ,, 2	1·22
,, ,, 1	0·85
,, ,, 0	0·59

These burners were by well-known makers; but there are plenty of cheap German nipples in the market which will give even worse results. In the above table No. 7 is the largest flat-flame burner given, as any larger size would never be used for indoor illumination; but with some of the big flat-flame burners employed for outdoor work as much as three candle-power per cubic foot of gas is developed by the best make, while it is also quite possible to find cheap imitations of them, which can scarcely be distinguished by their appearance, only developing a little more than one candle per cubic foot. It seems probable that 10-candle units represent the maximum light to be obtained in practice per cubic foot from the so-called 16-candle coal-gas, as, although greater regeneration will increase it as high as sixteen units, the heat is so intense that the burner is quickly destroyed. Taking 10-candle units as being the maximum amount of light for a consumption of one cubic foot of gas per hour, an approximate idea of the waste of illumination which attends the ordinary methods of burning the gas can be formed.

If the burners most commonly in use in houses be examined they will be found to consist chiefly of No. 4 and No. 5 flat-flame nipples, and it would not be over-estimating the number in use to put them at 85 per cent. of the total. The remaining 15 per cent. is made up of larger flat-flame burners, argands, and regenerative lamps, which give a higher service; but it will be found that the total value obtained will not exceed 2·5 candles per cubic foot. This means that 75 per cent. of the total value obtainable from the gas is wasted, and that for our present expenditure in coal-gas we could obtain four times as much light.

Mr. George Livesey some time ago proposed that unenriched coal-gas should be supplied to the consumer at a lower rate than is at present charged for the enriched 16-candle gas, and this question is of such interest and importance to both consumer and gas company that it deserves the gravest consideration.

In large towns like London, where the gas companies have to supply a gas of specific illuminating power, and where the gas is continually subjected to photometric tests at stations spread over the whole area supplied (any deficiency in the lighting value of the gas being visited with rigorously enforced penalties), enrichment in some form or other becomes a practical necessity. In London the gas has to have an illuminating power of sixteen

candles; and in order to ensure this over so enormous an area, the gas must be sent from the works testing up to from 16·5 to 17 candles. With seaborne Durham coals of the character most largely used in the metropolis for gas-making, the illuminating value of the gas will be about fifteen candles, and the gas manager has to enrich the gas by from 1½ to 2 candles before he can with safety send it out for distribution. This enrichment is done in several ways: (*a*) by the admixture of a certain percentage of cannel coal with the original gas coal; (*b*) by carburetting the coal-gas with the vapours of volatile hydrocarbons; (*c*) by mixing the gas with carburetted water-gas; (*d*) by admixture with rich oil-gas.

Up to four years ago the admixture of a certain percentage of cannel coal with the Durham coal was the only method of enrichment employed by the metropolitan companies, and was perfectly satisfactory, as the coal being mixed, the gases came off together under the same conditions in the retorts, and a uniform gas was the result. During the past few years, however, the increase in price of cannel has forced the gas companies to find some other process which should take its place, and the Gas Light and Coke Company tried experiments which led to their largely adopting carburetted water-gas for this purpose.

When steam acts upon carbon at a high temperature, the resulting action may be looked upon as giving a mixture of equal volumes of hydrogen and carbon monoxide, both of which are inflammable but non-luminous gases. The water-gas is then carburetted, *i.e.* rendered luminous by passing it through chambers in which oils are decomposed by heat, and the mixture of oil-gas diluted with water-gas is made of such "richness" as to give an illuminating value of 24 or 25 candles, and this, mixed with the poor coal-gas, brings up its illuminating value to the required limit. During the winter months the gas supplied by the Gas Light and Coke Company has mostly contained about 10 per cent. of the carburetted water-gas.

This form of enrichment has several serious drawbacks: it increases the percentage of the highly-poisonous carbon monoxide in the gas, and so makes leakage more dangerous, whilst carburetted water-gas burns with a short but very brilliant flame, far shorter than coal-gas, a 22-candle water-gas flame burning from a London argand at the rate of 5 cubic feet an hour, with a flame only 2½ inches in height; whilst a 16-candle flame of the gas supplied up to three years ago gave a flame three inches in height; and the gas now supplied and enriched with the carburetted water-gas only gives a flame 2·6 inches in height, in order to emit a light of 16 candles.

When a householder lights his gas-burners, he invariably turns on the gas until he gets the largest possible flame without roaring or smoking, and from the alteration in the composition of the gas which has taken place, this means using far larger quantities of gas than heretofore, so that although an increase in illuminating power is obtained, a substantial increase in the quarter's gas bill is also found.

Another objection to this form of enrichment applies even still more to the admixture of rich oil-gas with the poor coal-gas, and is that although gases of different gravities mix perfectly well in small vessels, yet when you come to deal with the huge gas-holders used in the modern gas works, stratification of the gas takes place, and even if the enriching gas be mixed with the ordinary gas in the foul mains, so that they may pass through the scrubbers and purifiers together, uniformity in illuminating power is never obtained, and with the London coal-gas variations of from 16 to 18 candles in value are found at the testing stations.

A burner which is giving its best duty with a 16 candle gas, will be very apt to smoke when burning a gas of higher quality, and under these conditions the products of combustion become more injurious to health from the presence in them of a larger proportion of the products evolved during incomplete combustion.

Enriching gas by the vapours of volatile hydrocarbons enables the manager to bring his gas up to the legal requirements as regards the illuminating value at the testing stations, which are mostly fixed where the great trunk mains deliver the gas to the districts to be supplied, and it is only under exceptional circumstances that the illuminating value of the gas is ever found to be below the required limit at these points. The consumers, however, reap but little benefit from it, as the loss of illuminating value during distribution is very great where this method of enrichment is employed.

No matter how enriched, change of temperature, and other troubles incidental to distribution generally reduce the illuminating power of the gas to a considerable extent before it reaches the consumers' burners, so that its actual value is far more often fifteen candles, although it may have been tested over sixteen at the station.

In the big mains the gas is continually flowing at a fairly steady rate, and is neither exposed to any great alteration in temperature, nor from the size of the mains to any very great amount of "skin friction," *i.e.* rubbing of the gases against the sides of the pipes; but as soon as distribution commences, both these factors come into play, and as some of the chief illuminants of the gas are vapours and not permanent gases, lowering of temperature causes condensation of some of them, whilst the power which friction against the sides of the main service pipes, coated with deposited hydrocarbons, has of withdrawing the illuminants from the gas, still further decreases its light-giving value, and anywhere near the dead end of a service, stagnation of the gas during a large portion of the twenty-four hours when gas is not being consumed, adds still further to the trouble, so that even at the testing stations, the influence of the small consumption of gas on Sundays, and consequent stoppage in the manufacture on that day, can be traced in the illuminating value found on Monday morning.

Coal-gas, as made from Durham coal at the temperature employed in the Metropolitan Gas Works, has an illuminating value of about fifteen candles, and the enrichment of this gas up to the required value costs far more *pro rata* than the amount of light obtained from the unenriched gas.

This cost has entirely to be borne by the consumers, and the whole practical question to be decided resolves itself into—"Is the game worth the extra candle and a half?"

If coal-gas were used for illuminating purposes only, the consumer would be a considerable gainer by having the unenriched gas supplied at a lower price; and when we consider the amount of gas used as a fuel, and that the quantity so employed is daily increasing, the cost of the enriched gas becomes of the greatest importance.

The value of one candle in illuminating power in the gas supplied in London at 1½*d.* per candle is £180,000, and if this calculation be correct, consumers in the metropolis would be saved about £270,000 a year by using unenriched coal gas, and probably not one of them would notice the slightest difference in the light emitted by the gas in the burners ordinarily in use.

In the regenerative burner the increase in illuminating value is almost entirely due to the rise in temperature causing methane, which forms about 34 per cent. of the coal-gas by volume to become a very valuable illuminant, and as there is just as much or more methane in the unenriched gas, it is manifest that this increase will still be found.

In the incandescent burner the coal-gas is burnt in an atmospheric burner, and the non-luminous flame is made

to heat a mantle of refractory material up to incandescence, and for this purpose the 15-candle gas will do as well as the 16.

One argument which has been raised against the lowering of the standard is that if a 16-candle gas is reduced to 15 candles during distribution, a 15-candle gas will be lowered to 14. This I think is a mistake. An enriched gas is lowered in illuminating value because certain vapours are condensed from it; but it will be found that with an unenriched gas, made at a high temperature, this action is decreased to a minimum, on account of the small proportion of vapours present.

One of the most important experiments ever tried on a large scale has been made this year, the London County Council having given permission to the South Metropolitan Company to supply unenriched gas to South London for the space of a fortnight, in order to practically ascertain the result during distribution and the loss of light to the consumer.

At the testing stations the gas for the fortnight showed the average value of about 15 candles, ranging from 14 to 16 according to the coal used at the various works, whilst tests made with portable photometers on the consumers' premises gave identical results, before, during, and after this period, clearly showing that the whole value of the enrichment consisted in satisfying the legal requirements, whilst the consumer gained absolutely nothing but the privilege of paying for it.

It is to the interest of the gas consumer and gas company alike that the price of gas should be reduced to the lowest possible figure, and the possibility of reduction in price is entirely dependent upon the discarding of the costly enrichment.

Under the present legal conditions the companies gain nothing by supplying a gas a candle better than the standard, and if they fall a candle below have to pay the absurd fine of 40*s.*, a state of things which if the London companies did not show the greatest anxiety to fulfil all their obligations might lead to a considerable reduction in the value of the gas distributed, as to pay a daily fine and to send out gas of a value of 15·1 candles would save the companies many thousands a year.

This is all manifestly wrong, and if the consumers are to get the full benefit of coal-gas, and if coal-gas is to take its proper place as a fuel as well as an illuminant, its sale must be placed on a sound commercial basis. Enrichment should be entirely given up, and the gas that can be made direct from the coal supplied to the consumer.

A minimum of illuminating value should be fixed for each town based upon the coal used, and any fall below this should be visited by a fine of £50 for the first half-candle, and an increment of £100 for each half-candle below that, whilst the price charged for the gas should be governed by its illuminating value for the quarter as averaged from the testing station returns, a low initial price, say 2*s.* 2*d.* per thousand, being charged for 14-candle gas, and 1½*d.* a candle for each candle above it, with a maximum price of 2*s.* 5*d.* If some such scheme as this could be adopted, not only would the consumer obtain the full value for his money, but the gas companies would reap the benefit of an enormously increased consumption for fuel purposes, and the atmosphere of our big cities would gain in proportion.

VIVIAN B. LEWES.

NOTES.

THE Council of the Society of Arts have, with the approval and sanction of the President, H.R.H. the Prince of Wales, awarded the Albert Medal to Sir Joseph Lister, Bart., F.R.S., "for the discovery and establishment of the antiseptic method of treating wounds and injuries, by which not only has the art of surgery been greatly promoted and human life saved in all parts of the world, but extensive industries have been created for the supply of materials required for carrying the treatment into effect."

WE are requested to state that before long a memoir of the late Dr. James Croll, F.R.S., will be ready for publication. Persons having letters from Dr. Croll, or information likely to be of interest, are requested to forward such to J. C. Blackwell, 10, Royal Terrace, Edinburgh. The letters will be returned when their contents have been noted.

A PASTEUR Institute was opened at Tunis on Tuesday by Dr. Loir, a nephew of M. Pasteur.

THE death is announced from Paris of M. Ed. Lefèvre, known for his work in entomology and botany.

PROF. CANNIZZARO has been elected a correspondent of the Paris Academy of Sciences, in the place of the late M. de Marignac.

WE learn from *La Nature* that a department of agricultural entomology has recently been formed at the Institut National Agronomique, and placed under the direction of Prof. Brocchi The work of the department will be to identify insects sent for that purpose by agriculturists, and to point out the means of destroying insect pests or diminishing their ravages.

THE *Cape Times* says that among the latest accessions to the South African Museum are an old imperfect skull and other bones of a white rhinoceros, presented by Mr. W. G. Schmidt. These remains of the now all but extinct "white" or Burchell's rhinoceros were found at a depth of about 8 feet, in black turfy soil, at about twelve miles from the Vaal River.

A COMPLETE statement has been issued of the different sections of the Mining and Metallurgical Exhibition to be opened at Santiago in September next. The classification is as follows:—(1) Motive Power; (2) Electricity; (3) Mining Machinery; (4) Mechanical Preparation of Minerals; (5) Metallurgy; (6) Chemical Industries; (7) Statistics and Plans; (8) Mining and Metallurgical Products.

THE Paris correspondent of the *Times* reports that, at the first meeting of the 1900 Exhibition Commission, the following scheme of classification was read:— The first group of exhibits is entitled "Education," and contains six classes. Group II. comprises "Works of Art," containing paintings, drawings, engraving, lithography, sculpture, the cutting of precious stones, and architecture. Group III. is called "Instruments and General Processes of Literature, Sciences and Arts," including typography, photography, binding, newspapers, maps, instruments of precision, coins and medals, medicine and surgery, musical instruments, and the theatrical art. The IVth Group is "The *Matériel* and General Processes of Mechanics," including steam engines, motors, divers apparatus of general mechanics, and implements. The Vth Group deals with electricity, including the production and mechanical application of electricity, electro-chemistry, electric lighting, telegraph, and telephone. Then come locomotion, agriculture, horticulture, forestry, alimentation, mines, furniture, textiles, chemicals, social economy, and military weapons.

IT is reported by the *British Medical Journal* that a committee of the Calcutta municipality have resolved to recommend that a sum of money be voted for two years in order to test thoroughly M. Haffkine's system of cholera inoculation. This method, worked out by M. Haffkine in the Pasteur Institute

in Paris, and applied extensively in India by the investigator himself, was recently put to the test of actual experience near Calcutta. Dr. Simpson, the health officer, took special steps to make the inoculations in the neighbourhood of Calcutta serve as tests, as severely scientific as possible, of the efficacy of the method in man. Of the 200 inhabitants of a native hamlet, 116 were inoculated with the protective vaccine. Not long afterwards, an outbreak of the disease occurred in the hamlet; ten persons were affected, none of whom had been inoculated, and seven died, whereas all those who had been inoculated remained free. If the results of future experiments are favourable, a permanent department will probably be established to carry on the inoculations.

THE Hong Kong correspondent of the *British Medical Journal* gives the following particulars with regard to the epidemic noted in our last issue:—"The plague commenced here on May 5; it presents all the symptoms of the true bubonic pest which devastated Europe in the Middle Ages, and produced the terrible ravages described by Defoe during the great plague in London. This bubonic pest, although extinct in Europe, has never ceased to prevail in China from time to time, and has also spread from there to Persia and Asiatic Russia. The present outbreak is characterised by intense symptoms corresponding to those of typhus, and by the bubonic boils characteristic of the disease. The deaths up to to-day have amounted to 1708, but I am glad to say that the Europeans here are unaffected except in the case of ten of the military employed by the authorities in carrying out disinfecting work in the native quarter where the plague is located; one of them has unhappily died." It is pointed out by our contemporary that this bubonic pest is extremely contagious from person to person, and though aërial infection is not unknown in connection with it, it is so probably only to a slight extent. Like typhus, the plague is mainly diffused by personal contact, and its diffusion is one of the results of overcrowding and dirt.

The U.S. National Academy of Sciences is in a quandary. According to the *American Naturalist*, it has been in a state of paralysis for two years as regards the election of members, owing to the impossibility of concentrating a sufficient number of votes on any one candidate to elect him. At present fifty-eight members are devoted to the physical sciences, and thirty-one represent the natural sciences. Members of the latter class desire to destroy this disproportion, but they cannot procure enough votes to elect an additional member on their side, and the result is a deadlock. It has been proposed by a committee that the Academy be divided into classes, each having a fixed membership, such as exists, for instance, in the Paris Academy of Sciences. Three of these classes were to embrace the physical sciences; two, natural science; and one, the sciences that could not be well classified under either of those heads. This, however, has been objected to, and Prof. E. D. Cope has submitted the following division to the consideration of the committee. Class I. (35 members).—Physical Science (Sciences of Energy); to include Physics, Astronomy, Chemistry, Physiology, and Dynamical and Chemical Geology. Class II. (35 members).—Natural Science (Sciences of Morphology); Structural Geology, Mineralogy (apart from Chemistry), Biology (including Embryology and Palæontology). Class III. (15 members).—Anthropological Science (Sciences treating of phenomena determined by psychic conditions); Antropology, Statistics, Philology, Psychology. Class IV. (15 members).—Applied Science. (Applications in the Arts of any of the Sciences previously enumerated), including Hygiene, Engineering, &c.

SUESS' famous work, "Das Antlitz der Erde" (the Face of the Earth), is to be translated into French by M. de Margérie. Abroad, the book is almost as well known to the general public as to geologists, but there seems to be no immediate prospect of an English translation.

WE are reminded of what we lose in this respect by a current article in the German "Weekly Magazine of Science" (*Naturw. Wochenschrift*, May 27 and June 3), on "the Flood and the Ice Age Question." The writer, Richard Hennig, discusses the views so amply stated by Suess in the aforesaid work, also those of Neumayr in the "Erdgeschichte" (History of the Earth). Suess and Neumayr may be said to have proved that the Mosaic account of the flood was copied, with but little alteration, from the original Assyrian version, and that the actual events took place in the plains of the Euphrates and Tigris, and not on the banks of the Jordan. Suess suggested a comparison with the occasional calamities caused in the lower parts of the rivers of India when a cyclonic storm whirls the sea inland, and the rivers overflow wide reaches of town and country. In Suess' opinion the Mosaic flood was of local nature:—"The traditions of other peoples do not in the least justify the assertion that the flood extended beyond the lower course of the Euphrates." Science went with Suess, and the true tale of the flood, while it remained picturesque, lost its magnificence.

NOW, however, Hennig brings forward persuasive arguments in favour of the independent origin of the flood Saga found among so many peoples. He associates it with some of the striking facts which indicate a general increase of rainfall and lowering of the temperature over the whole earth during the Quaternary period—*e.g.*, the presence of enormous lakes in the west of North America, whose water-level rose 1000 feet above the present Salt Lake of Utah, the Ice age and glaciation in North America and in Northern and Central Europe (without which geology would have lost a pet hobby), the floods which accompanied the retreat of the glaciers, the moist climate of Siberia, and the fertility and forest-growth in the now arid Sahara. Hennig concludes that the flood was contemporaneous with the Ice age, and was produced by the unknown causes which then lowered the temperature of the globe. The period was a prolonged one, during which the countries in milder latitudes were converted into swamp and sea, or underwent higher floods of local character under special meteorological conditions. Isolated lands remained free from inundation, Egypt for example, owing to their distance from any region of ice and dry climatic conditions.

THE German Saga tells how "the floods of the north came far from their home and were turned into ice, and the ice stood still, and the mist which hung over it froze . . . . till the hot sun-glow from the south met the hoar, and the frost fell in drops. The sun was strong and his heat gave life to the drops, so that a great frost-giant in the form of a man arose—Ymir of the Hrimthursen. But Börs killed the giant Ymir, and when he fell there ran so much blood from his wounds that the race of the Hrimthursen was drowned, all except him they called Bergelmir. In a boat he saved himself and his wife, and from them sprung the new race of Hrimthursen." The German Saga is scarcely less dramatic than the Eastern. After reading it we feel willing to believe that the Germanic Ossian was *bonâ fide*.

IN the *Programm des Gymnasium Ernestinum* (Gotha: 1894), Dr. A. Schmidt has published an essay on the employment of a trigonometrical series in meteorology, which will be very useful to students of the mathematical branches of that science. It is divided into four sections, the first two of which are devoted to the history of the subject, from their earliest use by Euler, in 1748. Their first application to meteorology is

attributed to T. Mayer, whose investigations were published after his death, by Lichtenberg, in 1775, although the principal merit for their employment in meteorology is undoubtedly due to Bessel, who explained their use in a treatise published in 1814. The last two sections deal with the means of deducing the harmonic constants from the usual formulæ, and the need of further investigations by this method. The *Programm* will probably not be generally accessible, but a careful summary of it, by Dr. Grossmann, will be found in the *Meteorologische Zeitschrift* for May of this year.

THE results of meteorological observations lose much of their interest when published four years late. Such is the report of the meteorological service of the Dominion of Canada for 1889, a copy of which has just reached us. We note in glancing through the volume that meteorological instruments are supplied to the experimental farms established in different provinces of the Dominion. There were 1126 warnings of approaching storms made during the year, 82·2 per cent. of which were verified. The railway companies in Canada give assistance in many ways to the meteorological service. One of these is by permitting trains to carry discs showing the weather forecasts for the districts through which they travel. A few weeks ago we noted that our Board of Agriculture intended to distribute in rural districts during harvest time, weather forecasts prepared at the Meteorological Office. It may be worth consideration whether such a system could not be usefully extended by displaying the predictions on trains running through agricultural districts.

THE earthquake in Baluchistan, described in NATURE of August 10, 1893, was also felt in South Russia and in Germany, and a comparison of the records at Nikolaiev and Strassburg is given by Herr E. von Rebeur-Paschwitz in the *Astronomische Nachrichten*, No. 3234. The epicentre of the earthquake was a spot fifty miles to the N.N.W. of Quetta. The main shock occurred at 12h. 19m. G.M.T. on December 19, 1892. The distances from Strassburg and Nikolaiev are 5290 and 3480 km. respectively. The first waves from the disturbance reached Strassburg in 16 min. with a velocity of 5·51 km. per second, this being about the same velocity as that observed in the case of the Wjernoje earthquake of July 11, 1889. The first maxima took 18 mins. and 30 mins. respectively to traverse the distances. It is very evident that the wave motion at some distance from the epicentre is very complicated. For several hours before and after the earthquake earth tremors, were recorded by the instruments, the two kinds of disturbances appearing to proceed independently of each other.

SOME interesting experiments with a rectangular glass prism are described by W. C. Röntgen in *Wiedemann's Annalen*. Those who have tried looking at themselves as reflected by two mirrors, placed at right angles to each other, will remember the amusing effect created by the image, contrary to the usual reflection in a mirror, not being reversed right and left. We can see ourselves "as others see us," also, by looking straight at the surface subtending the right angle of a rectangular prism. Herr Röntgen observes that in no case is the pupil divided into two equal parts by the faintly visible edge of the prism. This is an illustration of the angle between the line of vision and the axis of the eye, which is different in different people. Rectangular prisms can be easily tested for correctness of the angle by observing whether the two images of the cross-wires in a telescope, as seen in the two surfaces, coincide. The same test would tell us whether two mirrors are exactly at right angles—a fact which might be usefully applied for testing instruments like Gauss's heliotrope. Such a pair of mirrors, or a rectangular glass prism, give rise to another peculiar phenomenon. If they are rotated about the axis of vision, the image rotates in the same direction with twice the speed. If, therefore, the object, say a cardboard disc with writing on it, rotates twice as quickly as the mirrors or prism, it will appear to stand still. This might be applied to investigate the effects produced upon bodies by rapid rotation. Another peculiarity is that such an instrument will reflect rays falling upon the hypotenuse at any angle up to 45° to the same spot. By rotating such a prism about a line at right angles to its edge and to its hypotenuse the author was enabled to reflect the light from an electric lamp through a distance of 1 km. with ease and certainty.

IN a communication to the *Electrician*, Prof. Fitzgerald criticises Herr Lenard's last paper, a short abstract of which appeared in NATURE for May 31, 1894, p 114. In a former note on Herr Lenard's previous paper, Prof. Fitzgerald had pointed out that the experiments so far would be consistent with the supposition that the cathode rays were rays of light of very high frequency, except for the fact that they were deflected by magnetic force, a phenomenon of which we have no other evidence, and which makes it practically impossible at present to suppose that cathode rays are of this nature. It was further pointed out that if this deflection were an action on the emitting surface, and not on the ray, it might be again possible to explain these cathode rays by the supposition that they are rays of light. Herr Lenard's more recent experiments seem entirely at variance with any such supposition, while Prof. Fitzgerald considers that there is nothing in them that, in the same conclusive way, proves that they are not streams of electrified molecules or atoms. From Herr Lenard's observation that the deflection of the ray depends on the pressure of the gas in the tube in which the rays are generated originally, and not on the nature and pressure of the gas in the tube in which deflection takes place, it follows that, if the rays are paths of projectiles, they must either pass through the window, or else be projected from it, by some action which behaves like a blow given to it from the other side. A study of the spectrum of the cathode light might settle whether any of the molecules actually traversed the partition. The fact that there is no increase in the pressure within the tube only shows that as many molecules traverse the partition in one direction as in the other. Blows delivered on one side of a plate would project molecules from the other side, with different velocities depending on the nature of the blow and on the mass of the molecule, so that a hypothesis of this kind would be quite in accord with Herr Lenard's observations. The fact that the magnetic effect is independent of the mass of the molecule struck is explicable by supposing the electrical charge to be the same for all molecules. Even though sufficient reasons were forthcoming for rejecting the theory that these rays are due to projected molecules, Prof. Fitzgerald considers that there are other possible suggestions which are worthy of consideration, such that they are straight Grotthüs chains of molecules which bend under magnetic force. This might account for a velocity of propagation of actions along them, comparable with the velocity of light, without requiring the component matter to move with this velocity. In fact, until the residual matter within the tube has been reduced very much beyond what has been attained, and it has been shown that these phenomena increase instead of diminish, and that there is no very slow projection of the material of the plates, such as darkens the glass in glow-lamps, it will be very difficult to prove that any of the phenomena hitherto observed are due to the ether, and not to the matter present. So far the phenomena described are quite like those that would be due to moving electrified matter, and the actions are quite unlike anything we know of the properties of the ether.

THE anomalies which are constantly observed in culture for bacteriological researches have, up to the present, been

generally ascribed to abnormal conditions or to involution. Although the existence of polymorphism among bacteria may be inferred from the records of Metscknikoff, Weibel, Cornil and Babes, Kiessling, Karlinski, and especially those of Guignard and Charrin, as yet no absolute proof had been adduced to make it a fact. The *Weekblad v. h. Tydschrift v. Geneesk.* of April 28 contains an article in which the writers contend that among pleomorphic bacteria there are some species which, under different conditions, present different forms. Last year, when testing the water from the waterworks of Groningen, Ali Cohen and Uffelie, of the Hygienic Laboratory of that city, succeeded in cultivating in pepton Na Cl, fluid, spirilla which possessed all the morphological and biological properties generally ascribed to this species of organism. These spirilla, transplanted in nutritive gelatine, speedily developed colonies, but exclusively consisting of bacilli. These bacilli, replaced in a solution of pepton, Na Cl, reproduced again spirilla, not all identical, however, but consisting of commas, S forms, and short spirella. They repeated their experiments for several consecutive months, always with the same result. During these investigations another curious fact came under their notice. An organism which for several months, in alternate solid and fluid nutriment, had produced the alternate form of spirillum and bacillus, although the conditions of culture had not been altered in any way, lost at last the power of reproducing spirilla. The organism had retained all its individual characteristic properties, but it was impossible to revive this power. These observations led the writers to the conclusion that the present state of bacteriological science does not admit of ignoring the signs of polymorphy in bacteria, and that it is inaccurate to speak of normal and abnormal conditions, or to recommend as appropiate only those nutrients in which bacteria most speedily develop and accurately retain the form under which they are described in the text-books. The fact that most species of bacteria cultivated under glass gradually lose their power of multiplication, their loss of pathological and other biological properties, make this apparent. Even increased power of growth does not necessarily prove the exterior conditions to be favourable. It is well known that the bacillus of diphtheria loses its virulence in proportion as its power of development increases. In their opinion, therefore, it will henceforth be unsafe to deny, on morphological basis only, that the cholera spirillum may have developed from a certain form of bacillus, and that it is not invariably produced from an individual whom it morphologically resembles.

THE first volume has been issued of Dr. Bowdler Sharpe's "Handbook to the Birds of Great Britain." The book belongs to the new edition of Allen's Naturalist's Library, of which Dr. Sharpe is the editor, and Messrs. W. H. Allen and Co. are the publishers.

WE have received an excerpt from the Transactions of the Academy of Science of St. Louis (vol. vi. p. 481). Mr. Milton Updegraff is the author of the extracted paper, the subject of which is the determinations of the latitude, longitude, and height above sea-level of the Laws Observatory of the University of the State of Missouri, and the Observatory building and instruments.

THE *Bulletin* of the Royal Gardens, Kew, Appendix ii. for 1894, is entirely occupied by a list of new garden plants brought into cultivation for the first time in the year 1893, including botanical varieties and hybrids, as well as the most noteworthy of those which have been reintroduced after being lost from cultivation, and others now for the first time described or published with authenticated names.

PART ii. No. 4, of vol. lxii. of the "Journal of the Asiatic Society of Bengal" contains two papers by Dr. G. King, the Superintendent of the Royal Botanic Garden, Calcutta: "On some Indian Species of *Canarium*," and a continuation of his "Materials for a Flora of the Malayan Peninsula"; also an account of the Deep Sea Collection made during the season of 1892-93 in H.M. Indian Marine Survey steamer *Investigator*, by Dr. A. Alcock, Superintendent of the Indian Museum.

WE have received two important reprints from the "Sixth Annual Report of the Missouri Botanical Garden": North American species of *Sagittaria* and *Lophotocarpus*, by Jared G Smith, illustrated by twenty-nine beautifully executed plates; and a description, by W. Trelease, of *Leitneria Floridana*, a Floridan tree now for the first time discovered in south-eastern Missouri. The systematic position of this monotypic genus is still uncertain; the author being doubtful whether to place it near the Platanacea among Apetalæ, or near the Dipterocarpeæ or Balsamifluæ among Polypetalæ. This paper is also illustrated by fifteen excellent plates.

THE first edition of Dr. J. E. V. Boas' "Lehrbuch der Zoologie für Studirende und Lehrer" (Gustav Fischer, Jena) was reviewed in these columns at the beginning of 1891 (vol. xliii. p. 268). A second edition of the manual has now been published. No alterations have been made in the plan of the book, but emendations and numerous additions have been inserted here and there, so as to bring the matter in line with recent work. Nearly fifty illustrations have also been added.

THE tenth edition of "Quain's Elements of Anatomy" edited by Profs. E. A. Schäfer, F.R.S., and G. D. Thane, is slowly approaching completion. Messrs. Longmans, Green, and Co., the publishers of the work, have just issued the third part of vol. iii., dealing with the Organs of the Senses, and it is announced that the second part of this volume (Peripheral Nerves) will be published shortly. The fourth part (Visceral Anatomy) is in preparation, and will complete the work.

SO long ago as 1883 we reviewed (vol. xxviii. p. 195) the first part of "Field and Garden Crops of the North-Western Provinces of Oudh," by Mr. J. F. Duthie, the Director of the Botanical Department of Northern India. The second part was published a year after the first, but the third and concluding part, dealing almost entirely with garden crops, has only just reached us. All important plants of this kind, grown in India on comparatively small plots, are described and excellently illustrated. Mr. Duthie has added to the usefulness of his work by giving at the end of the part just received a general index to all the parts.

IN the Report of the U.S. National Museum for the fiscal year ending June 30, 1891, there are several papers describing and illustrating collections in the Museum, in addition to the reports of the various curators. Dr. G. Brown Goode describes the genesis of the Museum in an article full of information. The ethnological collections in the Museum from Kilima Njaro, East Africa, are enumerated by Dr. W. L. Abbott, and the Korean collections by Mr. Walter Hough, both papers being well illustrated. Mr. Romyn Hitchcock contributes three papers to the volume, one on Shinto, or the mythology of the Japanese, another on the ancient burial mounds of Japan, and a third on some ancient relics found in Japan. Finally, Mr. George H. Boehmer's exhaustive history of the prehistoric naval architecture of the North of Europe is included. This paper should be referred to by all who are interested in the development of the art of shipbuilding.

SCARCELY a week passes without our receiving several voluminous reports on scientific work carried out under the auspices of the United States Government. One of the last volumes to come to hand is the Report of the U.S. Commissioner of Fish and Fisheries for 1889-91. The Commissioner's report alone is a valuable summary of work, but this covers less

than one hundred pages, and the remaining 550 pages consist of papers upon various branches of inquiry. The subjects of these investigations are food-fishes and fishing-grounds, methods and statistics of the U.S. fisheries, the work of the U.S. Fish Commission steamer *Albatross*, the oyster resources and oyster fishery of the Pacific Coast of the United States, the coast fisheries of Texas, a review of the sparoid fishes of America and Europe, fish Entozoa from the Yellowstone National Park, and last, but not the least important, a translation of Prof. Haeckel's "Plankton-Studien," being "a comparative investigation of the importance and constitution of the marine fauna and flora." All these papers will be read with interest by students of marine biology.

SINCE 1844, Müller-Pouillet's "Lehrbuch der Physik und Meteorologie" (Vieweg und Sohn, Braunschweig) has passed through eight editions, and the ninth edition, edited by Dr. L. Pfanndler, only wants the second part of the second volume to complete it. There are three volumes altogether. Vol. i. treats of Mechanics and Acoustics, and vol. iii. of Magnetism and Electricity. The former appeared in 1886, and the latter in 1890. The publication of the second volume, dealing with Light and Heat, has been delayed owing to the removal of the editor to Graz University. Dr. Otto Lummer has, however, taken up the work where it was left, and the publishers have been able to issue the first part of the second volume, containing four chapters on Light. It is hoped that the remainder of the volume will be published at no very distant date. The whole edition has been thoroughly revised and greatly enlarged, the work, so far as yet published, running into more than 2200 pages. It is unfortunate that so many years should have elapsed between the publication of vols. i. and iii. and that the issue of vol. ii. should have been so long delayed. Owing to these differences of dates, the edition cannot be said to represent, as a whole, the state of physical science at any particular epoch. Like Jamin's and Ganot's and Deschanel's works on physics, that of Müller-Pouillet is amply illustrated. All experimental apparatus is fully described, and the objects accomplished with it explained in detail without the use of advanced mathematics. In a prefatory announcement the work is commended to those "welche nicht Gelegenheit finden, akademi-che Vorträge mit Experimenten zu besuchen." From this one could be led to believe that the manual was suitable for reading by a public debarred from seeing physical experiments performed. This, however, is not the case. The place of the work is among books of reference suitable for elementary students of natural philosophy, not with those designed for general readers.

THE additions to the Zoological Society's Gardens during the past week include a Bornean Ape (*Macacus inornatus*, ♀) from Borneo, presented by Mrs. Florence Firman; a Puma (*Felis concolor*, ♀) from South America, presented by Miss Florence Dickinson; a Leopard (*Felis pardus*, ♂), a Cheetah (*Cynælurus jubatus*) from East Africa, presented by Major Owen; an Isabelline Bear (*Ursus isabellinus*, ♂) from Cashmere, presented by Mr. E. Haag; a Sloth Bear (*Melursus ursinus*) from the Hills of Orrissa, Bengal, presented by Mr. J. W. Currie; a Downy Owl (*Pulsatrix torquatus*) from Brazil, presented by Dr. E. A. Goeldi; an Eroded Cinixys (*Cinixys erosa*) from Cape Lopez, Gaboon, presented by Commander J. L. Marx, R.N.; a Greek Tortoise (*Testudo græca*) from Greece, presented by Mr. H. K. Bartlett; a Hoolock Gibbon (*Hylobates hoolock*) from Assam, a Black-handed Teetee (*Callithrix melanochir*) from Brazil, a Black-winged Peafowl (♂) from Cochin China, five Heloderms (*Heloderma suspectum*) from Arizona, deposited; a Great Anteater (*Myrmecophaga jubata*) from South America, a Black Stork (*Ciconia nigra*), European, two Japanese Teal (*Querquedula formosa*) from North-East Asia, purchased; a Wapiti Deer (*Cervus Canadensis*, ♂), a Mouflon (*Ovis musimon*, ♀), a Yellow-footed Rock Kangaroo (*Petrogale xanthopus*, ♂), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

BRIGHT-LINE STARS.—Exact information about stars with bright lines in their spectra is appreciated by all who have the advance of celestial science at heart. In a paper in the June number of *Astronomy and Astro-Physics*, Prof. W. W. Campbell brings together all that is known with regard to objects of this spectroscopic character, and adds to the literature a number of important observations made by himself. Since 1867, when MM. Wolf and Rayet discovered three bright-line stars in Cygnus, fifty-two objects of the same type have been found, forty-two of this number being placed to the credit of the Harvard College Observatory. Prof. Campbell has made visual determinations of the positions of the lines in the spectra of thirty-two of these stars, and has also photographed the spectra in juxtaposition with a hydrogen comparison spectrum. One of the most noteworthy facts brought out by the observations is that the hydrogen lines in the spectra present a variety of forms and intensities. In many of the stars they are dark; in others, they are dark with bright borders. The bright hydrogen lines vary from faint to very bright, from monochromatic lines to very broad bands, and from those clearly single to those apparently multiple. Like many lines in the spectra of nebulæ, those of bright-line stars are difficult to identify with terrestial substances. The ubiquitous lines of hydrogen are certainly present, and Prof. Campbell finds that prominent lines of iron and other elements appear to coincide with a few of the star lines, while a line at wave-length 4480 suggests to him a magnesium origin, but the identifications are not sufficient to lead him to make any definite conclusions. Much more can be learnt from his comparison, in tabular form, of lines in stars of the Wolf-Rayet type with those found in the solar chromosphere, in Nova Aurigæ, and nebulæ; also with dark lines in Orion stars, and in β Lyræ. The hydrogen lines are shown to be prominent in all the six spectra. With the exception of the lines of hydrogen, D_3, and that at λ 4472, lines in the chromosphere do not furnish any striking coincidences with lines in Wolf-Rayet stars. The parallel columns of lines also fail to indicate any connection between these stars and Novæ, the only point of similarity being that the lines in both these classes of celestial objects are broad. As is well known, the nebular spectrum and that of bright-line stars are much alike. A close examination, however, has led Prof. Campbell to think that nine prominent star-lines do not occur in nebulæ; while, on the other hand, five nebular lines were unsuccessfully looked for in the stars. His deductions from the whole of the observations are summed up as follows:—"In conclusion, I think we can say that the spectra of the Wolf-Rayet stars are not closely related to any other known type. They appear to have several points in common with the nebular and Orion type spectra; but the last two appear to be much more closely related to each other than to the Wolf-Rayet spectra. It is therefore difficult to place these stars between the nebulæ and Orion stars. They certainly do not come *after* the Orion stars, and one does not like to place them *before* the nebulæ. We can probably say that the bright lines are chromospheric, owing their origin to very extensive and highly heated atmospheres, but showing very little relation, in constitution and physical condition, to that of our own sun. For the present, at least, this type of spectrum must be considered as distinct from every other known type, just as the nebular spectrum is distinct, and like the nebular spectrum containing lines whose origin cannot now be assigned."

EPHEMERIS FOR GALE'S COMET.—The following positions for Gale's comet are from the ephemeris given by Prof. Kreutz in *Astronomische Nachrichten*, No. 3229:—

Ephemeris for Berlin Midnight.

1894.	R.A. h. m. s.	Decl. ° ′	Brightness.
June 23 ...	11 54 33 ...	N. 43 1·4 ...	0·14
27 ...	12 2 16 ...	43 15·9 ...	0·12
July 1 ...	12 9 47 ...	43 25·5 ...	0·10
5 ...	12 17 7 ...	43 31·0 ...	0·09
9 ...	12 24 19 ...	43 33·5 ...	0·07
13 ...	12 31 26 ...	43 33·1 ...	0·06

THE ROYAL SOCIETY CONVERSAZIONE.

THE rooms of the Royal Society were crowded with a distinguished gathering on Wednesday evening, the 13th inst., the occasion being the annual Ladies' Conversazione of the Society. In accordance with our usual custom, we give descriptions of the most important exhibits not previously mentioned in these columns.

Prof. McKenny Hughes, F.R.S., exhibited specimens illustrating the evolution of the breeds of English oxen. The earliest breed, *Bison priscus*, belongs exclusively to the Palæolithic age. The next, *Bos primigenius*, commenced with *Bison priscus*, but outlived that species, and is characteristic of the Neolithic age. Both the above forms had disappeared before the arrival of the Romans in Britain. *Bos longifrons* appeared with *Bos primigenius*, but survived to Roman times. The Romans improved *Bos longifrons* by crossing it with some larger breed having straighter and more upturned horns. As there was no large native breed surviving, and, moreover, the characters of *Bos primigenius* do not appear in the cross, the Romans must have imported the breed with which *Bos longifrons* was crossed. The type of the Roman breed is still seen in the tawny Highland cattle (a larger variety of which is still common in Italy); in the black Welsh and Highland (such as were killed for funeral feasts); and in the Chillingham cattle (the descendants of the white sacrificial bull). All these are whole-coloured; the parti-coloured cattle are a much later introduction. After the withdrawal of the legionaries, there was soon no end of selection of stock, and the cattle, except those preserved in enclosures or isolated in the far West and North, reverted to the type of *Bos longifrons* as seen in specimens from the mediæval ditches round Cambridge.

Mr. Shelford Bidwell, F.R.S., exhibited illustrations of recurrent vision and retinal oscillations. For recurrent vision a moving patch of light, white or coloured, projected upon a screen, was followed at a short distance by a "ghost" or recurrent image, generally of a violet hue. To show retinal oscillations a modified form of Charpentier's experiment was used, demonstrating the brief period of insensibility to luminous impressions which follows the impact of light upon the eye.

The shell musical instruments (trumpets and flutes), exhibited by Dr. George Harley, F.R.S., included: (1) Shell fog-horn used by fishermen on the banks of Newfoundland (*Strombus gigas*). (2) Welsh shell trumpet used as a dinner summons (small *Strombus gigas*). (3) Miner's blasting signal horn, used in the Guernsey granite quarries (*Strombus gigas*). (4) Conch trumpet, blown at funerals and religious festivals in Southern India (*Turbinella rapa*—peeled and decorated with lotus flower). (5) Triton shell flute from New Guinea (*Triton tritonis*). (6) Helmet shell trumpet from New Guinea (*Cassis cornuta*). (7) Figure-ornamented triton trumpet from Japan. (8) Triton shell flute from Solomon Islands. The exhibitor expressed the opinion that shells were the first forms of trumpets and flutes ever employed.

Sketches of clouds, by Luke Howard, F.R.S, were exhibited by his granddaughter, Lady Fry. These sketches were lately found, unmounted, amongst the family papers of the late Luke Howard. In many cases they bear his initials, or remarks in his handwriting. They appear to have been drawn by him from instances which came under his own observation, during the time that he was conducting those studies which resulted in his work on "The Modifications of Clouds," and in his well-known nomenclature and classification. Some of them were copied for, and appeared in, his work. See also the "Einleitung" to Prof. G. Hellmann's recent reprint of Howard's work. (Berlin: A. Asher and Co., 1894.)

Original drawings of the "Milky Way," made at Birr Castle Observatory, were exhibited by Lord Rosse. These drawings, comprising one general view and three sections of same on an enlarged scale, represent the "Milky Way," as seen with the unassisted eye as far as 20° South Declination. They were reproduced by lithography on half the original scale by Mr. W. H. Wesley and published by Messrs. Longmans.

The Postmaster-General exhibited (1) Wheatstone's automatic transmitter, running up to 600 words per minute, driven by Willmot's air motor. The air motor in this instrument dispenses with the 42 lb. weight which, when the instrument is running at 600 words per minute, requires rewinding by the operator every few seconds. And since the motor is applied directly to the eccentric axle it dispenses with the whole of the train of wheel-work, the friction regulator and complicated fly-wheel. The speed of the instrument is regulated by opening or contracting the nozzle regulating the supply of air. The power required is so small that the instrument can be driven at a moderate speed by simply blowing into it with the mouth. (2) Prof. Hughes' type printing telegraph, driven by Willmot's air motor. The air motor in this instrument takes the place of the 132 lb. weight previously used, and dispenses with the whole of the winding gear, and nearly all the train of wheel-work, the motor being applied directly to the printing shaft. The motor is self-starting in any position, and will run continuously without any aid from the operator.

Messrs. John I. Thornycroft and Co. had on view a case containing models of torpedo boats, light-draft patrol steamer, and the "Thornycroft" water-tube boiler.

A sonometer for measuring the relative and comparative perception of hearing was exhibited by Mr. T. P. Hawksley. The instrument consists of two primary coils of unequal winding; between them slides a secondary coil, two dry cells, or a thermopile supply current, which is made intermittent by an adjustable rheotome. The secondary coil is connected to a deep note telephone, from which proceeds a tube to be applied to the ear. A condenser may be used. At one point on the scale the interruptions of the rheotome are not heard in the telephone, but on approaching the secondary coil to one of the primary coils, the interruptions gradually increase in loudness until they become unbearable to the ear.

Mr. J. Wimshurst exhibited models showing an improved method of communication between shore stations and light-ships, or other like purposes. The method consists in arranging suitably wound coils of insulated wire upon the swivel pin of the moorings, the one coil being in communication with the shore station and the second coil in communication with the ship. Signals, or sound, are transmitted by induction, or by electromagnetic induction.

Mr. Charles Bradbury's exhibit was the "Brunsviga" calculating machine, for plain figures or decimals. The "Brunsviga" is an arithmometer constructed on an entirely new system, and will add, multiply, subtract or divide with absolute accuracy, giving products up to 13 figures (ordinary size) or 18 figures (large size). The handle is turned in one direction for addition or multiplication, and in the reverse direction for subtraction or division. This machine is used at the Royal College of Science, the City and Guilds Technical College, the Millard Laboratory at Oxford, the Postal Telegraphs Department, &c.

Mr. Charles Baker showed apparatus for obtaining instantaneous photo-micrographs, and viewing the image until exposure is made. The apparatus consists of a case containing a metal shutter, carrying a prism, and connected with a pneumatic release. When this shutter is set the image in the microscope is projected, by means of a prism, on to a screen, which is fixed in an adjustable tube at right angles to the optic axis, and can be viewed and focussed up to the moment of exposure. To ensure accurate focus, the screen in the adjusting tube should be placed the same distance from the microscope as the plane of the sensitised plate. A slit in the shutter can be opened or closed to regulate the exposure.

The exhibit of the Marine Biological Association included: (1) Living pelagic larvæ, &c., from Plymouth. (2) Examples of the echinoderm fauna of Plymouth. (3) Hybrid between brill and turbot (North Sea). (4) Sole with an eye on each side of the body. The usual distortion, due to the shifting of the left eye to the right side, had not occurred (North Sea). (5) Plaice larvæ, up to 28 days' old, reared from eggs hatched in the Plymouth Laboratory. The organisms exhibited were either of economic or of scientific interest.

A method of heating by electricity for hospital purposes was shown by Mr. C. T. Snedekor. By means of this electrical mode of generating heat it is possible to obtain and maintain uniform any required degree of temperature. The apparatus is enclosed in an elastic and flexible case, with a silk or woollen covering, so that it can be applied to and envelope any part of the body as a fomentation. It can also be used for a domestic Turkish bath, or used as a footwarmer, and generally for warming purposes in the bedroom or carriage.

Prof. Oliver Lodge, F.R.S., exhibited a compact and sensitive detector for electric radiation, and a spherical radiator of short Hertz waves. The apparatus consisted of a small copper cylinder containing a piece of zinc and sponge, forming a battery,

a coil and suspended needle-mirror, forming a galvanometer, and a ball contact or "coherer," or else a tube of filings, in circuit with the other two. Electric surgings in the air, or in a scrap of wire pegged into the lid, increased the conductance of the circuit. A light tap on the cylinder reduced it again. A handy lamp and scale enabled the deflexion of the needle to be seen. The surgings could be excited by giving sparks to an insulated sphere not far off, especially if the knobs supplying the sparks are well polished.

The exhibit of Dr. E. C. Stirling, C.M.G., F.R.S., was a series of fourteen photographs, with two maps and a geological section illustrating the researches carried on at Lake Callabonna, in South Australia, for remains of Diprotodon and other extinct animals, in 1893. A description of the work to which these photographs refer is given in another part of this number.

Gold leaf made by electro-deposition was exhibited by Mr. J. W. Swan, F.R.S. This exhibit illustrated an attempt to produce gold leaf by electro-chemical instead of mechanical means. The leaves were prepared by depositing a thin film of gold on a highly polished and extremely thin electro copper deposit. The copper was then dissolved by perchloride of iron, leaving the gold in a very attenuated condition. The leaves were approximately four millionths of an inch thick, and some of them mounted on glass showed the transparency of gold very perfectly when a lighted lamp was looked at through them.

Miss Edna Walter and Mr. H. B. Bourne had on view a projective goniometer. By means of this instrument, devised and constructed by the exhibitors, the projection of a crystal on a sphere is actually accomplished, realising in practice the fundamental assumption of the theory of crystallography; the instrument is thus of value in demonstrating the axioms of the science. If necessary, angular measurements could be made from the image, but these only attain an accuracy of about 40′ in 60° = one per cent., which is inferior to that attained with a goniometer.

Lord Kelvin showed a model illustrating the molecular tactics of a quartz crystal. The crystalline molecule was represented by a regular hexagonal prism of wood, the long diagonal of the hexagon being ·95 of the length of the prism. This gave in the assemblage representing a quartz crystal of regular form, the correct angle (38° 13′) between the faces of the prism and the faces of the terminal six-sided pyramid. Each crystalline molecule was marked on alternate sides with slips of blue and red paper, to show the orientational difference between the alternate sides of the prism and the absolute difference between the alternate faces of the pyramid. The coloured slips were placed obliquely to give the chiral quality of the crystalline molecule and of the assemblage. Right-handed and left-handed molecules were shown. All the piezo-electric and pyro-electric properties of the crystal (including the chiral piezo-electric property discovered by Voigt) would be actually produced in the model, if copper and zinc were substituted for the red and blue paper, and the individual prisms separated by elastic insulating material. The model showed the well-known orientational macling on two faces of the prisms, and the contiguous pair of faces of the terminal pyramid.

Dr. Isaac Roberts, F.R.S., showed original negatives and enlarged photographs of the spiral nebulæ Messier 74 Piscium, Messier 101 Ursæ Majoris, Messier 65 and 66 Leonis, Herschel I. 168 Ursæ Majoris, Herschel I. 56 and 57 Leonis. These photographs revealed the forms and structures of the spiral nebulæ with much greater detail and accuracy than had previously been known. They also clearly showed that the spirals were almost perfect geometrical figures, but broken up into numerous stars, or star-like condensations of the nebulosity, or of the meteoric matter, of which they are probably composed, and thus furnish strong evidence of the truth of the nebular or of the meteoric hypotheses.

A number of specimens illustrating locomotion phases in decapod crustacea were exhibited by Prof. Stewart, who also showed mummy cloth, of not later than 4000 B.C., compared with finest Irish linen of to-day. The piece of mummy cloth, made not later than 6000 years ago (IVth Egyptian Dynasty), was shown by the side of a piece of finest Irish linen 140 × 140 of to-day. The strands of the mummy cloth were 300 × 150 per inch.

Specimens of metallic chromium, manganese, tungsten iron, &c., free from carbon, also fused alumina, obtained during reduction of the metallic samples, were exhibited by Mr. Claude Vautin. The specimens of metallic chromium, manganese, &c., had been reduced from their oxides by means of metallic aluminium. The oxide of the metal to be reduced was intimately mixed with finely divided aluminium, and heated in magnesia-lined crucibles. The heat produced by the oxidation of aluminium during the operation was sufficient to fuse alumina, specimen of which was exhibited.

Prof. A. M. Worthington, F.R.S., and Mr. R. S. Cole exhibited photographs of a splashing drop. The photographs shown were obtained by allowing a drop to fall in absolute darkness, and illuminating it at any desired stage of its splash by a suitably timed Leyden jar discharge taking place between magnesium terminals. The exhibit comprised (1) shadow photographs obtained when a drop of mercury fell on the sensitive plate itself, which was laid horizontally and illuminated from above; (2) objective photographs, showing much more detail than has usually been obtained in such instantaneous work, and illustrating the exquisite sensitiveness of the very rapid modern plates. To obtain these photographs the spark was produced at the focus of a deep, silvered watch glass subtending an angle of nearly 180°, and was brought very near to the place of impact. A single quartz spectacle lens was substituted for the usual lens of the camera, and thus the absorption of photographic rays by glass was avoided.

Mr. W. Kurtz (New York) exhibtted photographic prints in the natural colours, obtained by printing in the three primary colours only (Dr. Vögel's process). The prints shown were all of them printed in *three* colours only, some by surface-printing, the others by lithography; but in all cases the printing blocks were produced by photography. The process employed is as follows:—By the intervention of suitable media, three photographs are obtained, severally appropriate to the three primary colours composing the original picture or view required to be reproduced. From these three photographs, respectively due to the chemical action of the red, yellow, and blue rays of the spectrum, printing blocks are prepared, which being printed from in red, yellow, and blue ink, give the multi-coloured effects shown by the specimens.

Prof. Elisha Gray exhibited the telautograph, an instrument for transmitting intelligence by electricity. The writer at one station using a lead-pencil, attached mechanically to the apparatus, and writing upon ordinary paper, transmits to the distant station a facsimile of his handwriting, at his ordinary writing speed. Sketches, sketch-portraits, diagrams, plans, trade-marks, and the like, as well as the characters of hieroglyphic alphabets may also be transmitted.

The following exhibits, with demonstrations by means of the electric lantern, took place in the meeting room of the Society:—

The magic mirror, by Mr. J. W. Kearton. It was shown that the English magic mirror owes its peculiar properties to curved elevations and depressions in the polished metallic face, the elevations producing figures in shade by scattering of light, and the depressions, figures in light by condensing rays reflected from the mirror on to a screen. The figures in relief and intaglio are first produced by the action of any suitable acid on the metal plate, and are then polished down until they disappear to direct vision. The figures of the Japanese type of mirror are by-products in the process of manufacture, and arise from local yieldings of the face and back during polishing: the more rigid parts of the face, which correspond to raised metallic figures on the back, suffer a somewhat greater reduction from opposing greater resistance to the polishing tool.

As at the previous conversazione, Prof. E. B. Poulton gave illustrations of recent work upon the influence of environment upon the colours of certain lepidopterous larvæ.

Mr. D. Morris, C.M.G., exhibited and described a series of views illustrating the leading features of tropical vegetation.

A CHEMICAL METHOD OF ISOLATING FLUORINE.

A NEW salt of exceptional interest, the first member of a series of fluorplumbates, is described by Dr. Brauner, of Prague, in the June issue of the *Journal* of the Chemical Society. Dr. Brauner is well known in this country, having been Berkeley Fellow of the Owens College, Manchester, previous to his appointment to the chair of chemistry in the Bohemian University. Twelve years ago he described two compounds very rich in fluorine, $CeF_4 . H_2O$ and $3KF . 2CeF_4 . 2H_2O$, and showed that when heated they first gave up their water and subsequently evolved a gas which possessed an odour similar to that of hypochlorous acid, and which exhibited the

chemical properties expected of free fluorine. The compound now described is a fluorplumbate of the composition $3KF . HF . PbF_4$. It may be obtained by three methods. The first consists in treating the freshly precipitated hydrated oxide of lead, $Pb_3O_7 . 3H_2O$, a substance described by Dr. Brauner in the year 1885, with a mixture of hydrogen potassium fluoride and hydrofluoric acid. The fluorplumbate is separated from the lead difluoride simultaneously formed by crystallisation from hydrofluoric acid. The second method consists in substituting fluorine for oxygen in the plumbates of Fremy. Peroxide of lead and caustic potash, in the proportions of the compound $3KOH . PbO_2$, are fused in a silver crucible; the product is moistened with water, and then added gradually to excess of pure hydrofluoric acid. The filtered solution is evaporated to the crystallising point in a current of air, and as soon as crystals commence to form is placed in a vacuum desiccator. Crystals of the salt are then deposited. The third method consists in displacing the acetic acid in lead tetracetate by fluorine. One molecular equivalent of lead tetracetate is added to three equivalents of hydrogen potassium fluoride, HF . KF, dissolved in hydrofluoric acid; crystals of potassium fluorplumbate are formed upon evaporation, either in the air or *in vacuo*. Analyses of the crystals prepared by all three methods indicate the composition $3KF . HF . PbF_4$.

The needle-shaped crystals, which frequently attain the length of a centimetre, and are grouped radially, have been found to be in all probability monoclinic in symmetry, and ismorphous with the analogous fluorstannate described by Marignac.

Potassium fluorplumate is permanent in dry air, but becomes brown in moist air, being decomposed by water, with formation of hydrated peroxide of lead, hydrogen potassium fluoride, and free hydrofluoric acid. The effect of heat upon the salt is most interesting and important. The experiments should be carried out in a platinum tube. At 100°–110° the crystals remain unaltered. At 200° hydrogen fluoride commences to be evolved in small quantity. When subjected to a much higher temperature, after previous heating for several hours at 230°–250°, a gas commences to be evolved endowed with the odour ascribed by Moissan to fluorine. This occurs much below a red heat. The gas liberates iodine in such large quantities from iodised starch paper as to cause it to be deposited in crystals, and small crystals of silicon held in the open end of the tube not only burn with a vivid incandescence, but even with explosive violence. There can, therefore, be no question that the gas is free fluorine, and it would thus appear that Dr. Brauner has discovered a trustworthy purely chemical process of isolating the element. Potassium fluorplumbate loses its hydrogen fluoride almost completely at 230°, without losing more than a trace of fluorine from the lead tetrafluoride. Any small traces of hydrogen fluoride subsequently evolved along with the fluorine at the higher temperature may be readily removed by Moissan's method of passing the gas over potassium fluoride.

Dr. Brauner has already obtained evidence of the existence of a whole series of fluorplumbates, analogous to Marignac's fluorstannates, and is now engaged in studying the sodium salt.

A. E. TUTTON.

A SURVEY OF THE ENGLISH LAKES.

AT the last meeting of the Royal Geographical Society a paper was read by Dr. Hugh Robert Mill, on the Lake District of North-western England, of which the following is an abstract:—The lake district is a remarkably definite and symmetrical geographical unit. It may be roughly described as a circular mass of elevated land, highest in the centre, and furrowed by a series of valleys running from the centre toward the circumference like the spokes of a wheel. Most of these valleys contain long narrow lakes of considerable size, and of a different type from the small round mountain tarns which also occur in the district.

An account was given in the paper of the methods employed for ascertaining the depth and fixing the position of each sounding, and for mapping the resulting information. The lakes considered were Windermere, Ullswater, Coniston Water, Wastwater, Ennerdale Water, Buttermere and Crummock Water, Derwentwater, Bassenthwaite Lake, and Haweswater, each of which was found to have certain special characteristics which distinguished it from all the others. The soundings were carried out by the author, assisted by Mr. E. Heawood, Mr. Shields, and others.

There are two main types amongst these lakes, the shallow and the deep. The former, including only Derwentwater and Bassenthwaite, are the broadest of all the lakes; they average 18 feet in depth, their mean depth being only 25 per cent. of the maximum depth, a smaller ratio than for any other lakes. The bed of these lakes may be roughly described as an undulating plain, grooved and ridged into shallow hollows, and low shoals running parallel to the long axis of the lake. The configuration suggests that they may have been shallowed by glacial accumulations.

The second, or deep type, the shallowest of which has an average depth of 40 feet, and in which the average depth varies from 36 to 61 per cent. of the maximum depth, comprises all the other lakes except, possibly, Ennerdale, which combines the characteristics of both types. They are long, narrow, sometimes winding like Ullswater, or slightly curved in outline like Wastwater and Haweswater. The most characteristic lie in long narrow valleys with steeply sloping sides, and the slopes are continued under water with almost equal steepness, in some cases with greater steepness, and terminate in a nearly flat floor. The typical form of this class of lake is thus a steep-sided flat-bottomed trough, diversified along the slopes by the still steeper conical mounds of débris thrown down at the mouths of streams. In Haweswater the largest example of a delta occurs, nearly cutting the lake in two; while Buttermere and Crummock, lying in one uniform valley, are entirely separated, probably by the same action, and Derwentwater is also divided from Bassenthwaite by a broad alluvial plain. Although most of the lakes show only one clearly defined trough, the two largest are divided into distinct basins. In Windermere, the shoal on which Belle-isle and the other islands off Bowness, rise separates the deep and wide upper basin from the less deep and much narrower lower basin. In Ullswater each of the three reaches of the lake contains a definite basin separated from the others by broad or narrow bars. From one of these the island of Housebolm rises, a mass of strongly glaciated rock; but while the position of the basin to the south of it seems to confirm the glacial theory of the excavation of the hollow, the hollow to the north of the island is so situated as to make its origin by glaciation somewhat difficult to understand.

Three of the lakes have depths which descend below sea-level. In Wastwater 217 acres lie beneath sea-level, so that if drained to that extent it would present the appearance of a lake still 58 feet in depth at one point. Windermere, if similarly drained, would show a northern lake 3¼ miles long with a maximum depth of 90 feet, and 3 miles further south a narrower lake 1 mile in length and only 14 feet deep at its deepest, while south of this there would be a still shallower lagoon half a mile long. In Coniston reduced to sea-level there would probably appear one narrow lake 2½ miles long and 42 feet in maximum depths. All the other lakes are situated at such elevations that they do not approach sea-level in their greatest depths.

Altogether, the lakes which have been sounded and mapped cover an area of 20 square miles of unexplored territory. Contoured maps of the ten lake-basins under consideration have been supplied to the Ordnance Survey for incorporation on the official maps of the country.

THE RECENT DISCOVERY OF FOSSIL REMAINS AT LAKE CALABONNA, SOUTH AUSTRALIA.[1]

I.

FROM time to time notices have appeared of a remarkable discovery of fossil bones at Lake Mulligan in the interior of South Australia, but so far there has been no connected statement of what has been done in the way of developing the discovery. For reasons which will be evident, it is not yet possible to announce the results with anything more than a rough approximation, which leaves many interesting questions unsolved, or even untouched. Still, in view of its palæontological importance, it seems desirable that any available information should be given without further delay.

Necessarily a fragmentary and imperfect record, I trust the following account will, at least, afford evidence that the authorities of the South Australian Museum are fully alive to the interest of the issues involved, and that, so far as their not

[1] By Dr. E. C. Stirling, F.R.S., C.M.G., Hon. Director, South Australian Museum.

too ample means will allow, they are doing their best to prosecute successfully a work of some magnitude and difficulty.

One other preliminary statement seems necessary. Though the so called lake in which the fossils were found has been hitherto spoken of as Lake Mulligan, that name has never been officially conferred or recognised, and indeed it will not be found on any of the maps of South Australia. There prevails a very proper sentiment, unfortunately not always carried into action, that the native names of localities should, so far as possible, be retained. In this particular instance the euphonious native name Callabonna, which applies to a large watercourse leading into the lake and to an adjoining sheep-run seemed appropriate in all respects, save that the association of sound and idea might erroneously suggest the possession of the scenic beauties of an Italian lake by an area which is not only waterless, but also almost unsurpassable for barrenness and utter desolation. The name, however, has been approved by the Executive, and in future the locality will be known as Lake Callabonna, and will be so called in the following notes :—

PHYSICAL FEATURES OF THE LAKE EYRE BASIN.

As has often been observed, those who might form their estimate of the physical geography of South Australia from an inspection of its maps alone, would come to very erroneous conclusions. The numerous, and often immense, areas marked as lakes, and the plentiful streams which appear to supply them, deserve their names on rare occasions only. Ordinarily the lakes are only shallow, mud-bottomed, or salt-encrusted clay-pans, and the rivers dry water-courses, or it may even be that a definite channel is unrecognisable. Only after the heavy tropical rains, which at too rare intervals descend to these latitudes, do the rivers run for a brief period and the lakes contain water, though for some time afterwards the deeper parts of the water-courses may remain as water-holes, or chains of water-holes of greater or less size and permanence. Those, however, who have only seen the river channels dry, can have little idea of what torrents they may become under such circumstances. The flood waters of the Barcoo or Cooper, some few years ago, spread over a breadth of from forty to fifty miles on its way to reach Lake Eyre. Lake Eyre itself has occasionally been filled, and is then a vast inland sea over a hundred miles long and fifty broad, and, when full of water, might well have suggested great possibilities of internal navigation.

The area of these inland lakes presents roughly a division into a Western system, comprising Lake Gairdner and numerous adjacent smaller clay-pans ; a Central system, of which Lake Eyre, Lake Eyre South, and Lake Torrens are the chief members ; and an Eastern system, comprising, in their order from north to south, Lakes Gregory, Blanche, Callabonna and Frome. These three systems have no direct communication with one another ; in fact, they are separated by more or less elevated ground.

From the fact of some of the early explorers, in proceeding northwards, having struck the apparently unending margins and impassable beds of the huge clay-pans, either of Lake Torrens, of Lake Eyre, or of those of the Eastern group, all of them were for some time supposed to be continuous and to form one great lacustrine surface. Indeed, for many years a familiar feature on the maps of Australia was an immense crescentic, or horse-shoe shaped, area with its two horns, formed by the present Lakes Torrens and Frome, directed southwards. Eventually the progress of discovery enabled this horse-shoe to be broken up into the constituents now called Lakes Torrens, Eyre, Gregory, Blanche and Frome, as they now appear. It is easy to see, on reference to the map, how great the chances were that explorers, having once passed into the then unknown region enclosed within the concavity of this great system of clay-pans, should have had their further progress checked at the shores of one or other of them.

The constituents of the Eastern system, with which we are more immediately concerned, form a chain of clay-pans connected by intervening channels, and together they present a curve with its concavity directed towards the west. The whole of the series is, according to the most recent maps, included between the meridians of longitude 138° 50′ and 140° 20′ East of Greenwich, and the parallels of south latitude 31° 12′ and 28° 50′.

On those rare occasions when the flood waters of the Barcoo come down in sufficient volume, from the immense area which it drains in Southern Queensland, they pass into the Strzelecki, a large effluent which leaves the main channel at Innamincka, a place of melancholy memory in the history of Australian discovery, as close by the present settlement lie the remains of the ill-fated Burke, who perished in 1861 after a successful transit of Australia. These floods may then fill Lakes Gregory and Blanche ; the latter lake, indeed, was filled two years ago, when its waters remained fresh for six months. A channel from the Strzelecki leads into Lake Callabonna, and I am informed that this depression also was filled from the same source some years ago, a statement which is supported by the presence upon the sand-hills of numerous fragments of the eggs of fresh-water fowl and of bones of water-rats. On the older maps Lake Callabonna was depicted as a northerly extension of Lake Frome, and indeed these two are actually connected by a channel, but whether water has ever been known to flow from one into the other I have not been able to learn.

There is compensation for the unpromising physical features of Lake Callabonna, that will be afterwards described, in the fact that its bed has lately been shown to be a veritable necropolis of gigantic extinct Marsupials and Birds, which have apparently died where they lie, literally in hundreds. The facts that the bones of individuals are often unbroken, close together and frequently in their proper relative positions, the attitude of many of the bodies, and the character of the matrix in which they are embedded, negative any theory that they have been carried thither by floods. The probability is rather that they met their death by being entombed in the effort to reach food or water, just as even now happens in dry seasons to hundreds of cattle which, exhausted by want of food, are unable to extricate themselves from the boggy places that they have entered in pursuit either of water or of the little green herbage due to its presence. The accumulation of so many bodies in one locality points to the fact of their assemblage around one of the last remaining cases in the region of desiccation which succeeded an antecedent condition of plenteous rains and abundant waters. An identical explanation has been suggested by Mr. Daintree in his notes on the Geology of Queensland (*Journal Geol. Soc.* 1872, p. 275).

LAKE CALLABONNA.

Lake Callabonna, the description of which is, in its main features, applicable to its kindred clay-pans, has a length of over fifty miles. About ten miles wide at its northern extremity it narrows to four or five at the site of the recent excavations, which is some fifteen miles to the southward, and becomes still further constricted in the remainder. Its shores, especially on the eastern side, are as yet imperfectly surveyed, nor have, I believe, any levels been taken of its bed. Possibly, like Lake Eyre, it may actually be below the sea level, but in any case it is relatively low lying, for water-courses lead into it on three sides. The Mount Hopeless, Yerila, Woratchie, Hamilton, Parabarana, and Pepegoona Creeks, all of which rise in the Flinders Range, enter it on the western side, and the Callabonna and Yandama Creeks, rising in the Grey Range, on the east. Though these only run after heavy rain, they may then bring down a considerable quantity of flood water. As I have already stated, water can flow into it at the northern end by the Moppa-Collina Channel which communicates with the Strzelecki. The occasional character of the surrounding country may be best appreciated by reference to some of the names given by the early explorers and settlers, such as Mount Hopeless, Dreary Point, Illusion Plains, Mount Deception, Mirage Creek, which tell their own story of drought, difficulties, and disappointments.

Speaking generally, the bed of the lake is a great flat clay-pan, depressed, but very little, below the surrounding country. In the neighbourhood of the fossiliferous area, however, this prevailing flatness is broken by the existence of an aggregation of dunes or hillocks of fine drift sand, not exceeding thirty feet in height, and with the ridges running more or less north and south at right angles to the direction of the prevalent westerly winds. These dunes are so far discontinuous that, did the lake contain a very few feet of water, they would be converted into a number of irregularly-shaped sand-islets. From a foot to eighteen inches below their surface is a layer of loosely compacted sand rock in which were found the bivalve *Corbicula desolata*, Tate, now living in the Cooper River system, and the univalve *Blanfordia stirlingi*, Tate, not yet known to be living, though related to the common littoral species *B. striatula*.

The sand-dune area is about four miles long from north t

south, and about three miles wide. The camp of the working party was at first pitched on the east side of the most southerly hillock, but the extreme exposure of the site to the prevalent winds and sand-storms soon compelled a change to the opposite side. Northward of the sand-hills, so far as the eye can reach, the whole lake bed is an unbroken flat expanse, covered with gypsum crystals of all sizes, from which the reflection of the bright sunlight causes a glare painful to the eyes. The greatest distance in this direction reached by members of the party was eight miles. Here there are a number of brackish springs in the bed of the lake, each surrounded by a fringe of "bull-rushes" (*Typha* sp.), and on the way thither a peculiar oval mound was passed, consisting of an interior mass of soft black mud covered by a greyish crust, the whole structure quaking on pressure like a jelly. The size was about twelve feet long by eight feet broad and four feet high.

South of the camp is another flat expanse on which water very readily collects even after a light fall of rain. When this is dry the surface is white from the presence of a saline efflorescence, probably sulphate of sodium. East and west the group of sand-hills are separated from the mainland by salt-encrusted flats of about half a mile in width, which in dry weather are passable for camels and even for light vehicles, but are extraordinarily boggy and sticky after rain.

There are a few shallow water-courses near the camp, the general direction of which is from north to south, and in some parts of these salt water stands permanently. The soft black mud which forms their bed contains in many places much decomposing vegetable matter, and often stinks horribly from the evolution from it of sulphuretted hydrogen gas. In one place there is, in the bed of the water-course, a round black-looking hole standing full of water, which gave no bottom with soundings at twenty-five feet.

After a continuance of dry weather, the flats around the camp become coated with a white amorphous saline crust with this peculiarity, that it does not form on surface tracks, and these thus appearing dark amid the surrounding white ground, the scene suggests with singular force the appearance of footprints on a snow-field. On the other hand, whenever water (collected in the tracks and other indentations) has evaporated, which very soon takes place under the influence of the strong, dry winds of the locality, there are left behind large flat glistening prismatic crystals which, in excess of dryness, crumble into a fine white powder. Unfortunately, the nature of these crystals cannot now be precisely stated, as the samples collected have not reached Adelaide, but, from their shape and behaviour, there is little doubt but that they are composed of sodium sulphate.

Scarcely any vegetation relieves the prevailing desolation beyond stubbly "samphire plants" (*Salicornia*), which grow in patches upon the sand-hills, and rarely exceed two feet in height. Judging by the unusual thickness of their stems, some of these bushes must be very old. A few scattered and still more stunted bushes of the same plant grow upon the intervening flats. To the north and south of the sand-hills not a bush relieves the unbroken monotony of the level, white crystalline surface.

On the western side, not far from the margin of the lake, are the Mulligan Springs, where a station hut was formerly in occupation; but this has been for some time abandoned. The adjacent country is now under pastoral lease to the Beltana Pastoral Company, whose holding extends continuously to the westward for a distance of 150 miles. The eastern spurs of the Flinders Range, the highest summits of which reach an elevation exceeding 3000 feet, approach to within about twenty miles of the lake, and at Paralana, on the eastern slope of the range, there are hot springs. Callabonna Station, belonging to Messrs. Ragless Brothers, borders the lake on the east, and consists chiefly of sandy plains which stretch to, and beyond, the boundary of New South Wales. The station-house stands on Callabonna Creek, about four miles from the lake, and six from the camp. Further south is the Muloowurtina Station, belonging to Mr. D. McCallum. The distance from Adelaide in a direct line is about 400 miles, but to reach the lake by the ordinary routes necessitates a journey by rail of about that length and an additional 150 to 200 miles by road, according to the route selected. The whole journey thither occupies five to six days, or longer in bad seasons.

Such are the physical characters of this uninviting region; its geological features will be afterwards considered.

History of the Discovery.

During many years, and from many parts of South Australia, notably from the Lake Eyre district, the South Australian Museum has from time to time received teeth and fragments of *Diprotodon* bones, which were occasionally associated with fragmentary remains of Macropods, Crocodiles, Turtles, and large Birds.

Among such donations were some teeth and portions of the lower jaw, sent to us in 1885 by Mr. John Ragless, which were found by his son, Mr. F. B. Ragless, in a water-course at a depth of five feet, about two miles east of the margin of Lake Callabonna, and about twelve miles north-east of the place where the more recent discoveries have been made. It was not, however, until 1889 that the Museum obtained a very perfect skull, and several other bones in their entirety, from Baldina Creek, near Burra, a locality about a hundred miles due north of Adelaide. In the same year, from fragments found at Bundey, in the same district, we were able to restore incompletely another skull, which differs very considerably from the former. A little later a third, but more imperfect, skull was found at Gawler, twenty-five miles north of Adelaide.

Since the first discovery of *Diprotodon* remains in the Wellington Caves, by Sir Thomas Mitchell, in 1830, teeth and bones of this animal have been found over an extensive area which extends from the Gulf of Carpentaria to Victoria, and from the Darling Downs to the Lake Eyre Basin. They have also been found at Kimberley, in North-west Australia, and to the west of the head of the Great Bight; so that the *Diprotodon* appears to have had an immense range, and probably wandered over the whole continent of Australia.

The existence of bones in the actual bed of Lake Callabonna was made known to Mr. F. B. Ragless on January 10, 1892, by an intelligent aboriginal who described them as being very large and numerous, and two days afterwards Mr. Ragless himself visited the locality, which subsequently became the seat of operations. A few days later the place was visited by John Meldrum, who had been for some months in Mr. Ragless's employ, and by him some fragments were brought to Adelaide. These facts having come to the notice of the Museum authorities, Mr. H. Hurst, who had been previously engaged in geological and palæontological work in Queensland, was commissioned to inspect and report. The promising nature of the report of this gentleman ultimately led to the despatch to the lake of a party under his charge in January 1893.

The Work at Lake Callabonna.

Operations under Mr. Hurst's superintendence were continued for four months, during which time a considerable amount of material was obtained. Towards the end of June 1893, however, work, having been previously interrupted by rain, had to be finally discontinued in consequence of a heavy fall, and Mr. Hurst, with one of his party, returned to Adelaide, bringing with him as many bones as could be carried in a "buck-board" buggy.

At this stage it appeared desirable for various reasons that the work of excavation should be continued under the direction of a responsible Museum officer, and accordingly, at the desire of the Board of Management, I left for the field on August 11, 1893, in company with Mr. Zietz, the assistant director, and another member of the Museum staff. On our arrival at Lake Callabonna Mr. Hurst, who had by that time returned to the camp, resigned his appointment, with another member of his previous party.

As the result of Mr. Hurst's labours about a ton of bones were soon despatched to Adelaide. Shortly after our arrival a fall of rain, though not exceeding half an inch in amount, was sufficient to cause considerable sheets of water to collect on the low-lying flats, to fill up the holes which had been excavated, and to render the clay surface of the lake, at the best of times very soft and sticky, so boggy that further work on the field became for a time impossible. Further, it became a matter of great difficulty for the camels to pass over to the mainland for the requisite supplies, and it was occasionally necessary to remove their loads and dig them out of the glue-like mud in which they had sunk nearly to their bellies.

In consequence of the rain it was a fortnight before excavations could be properly resumed; meanwhile, being unfortunately obliged to return to Adelaide, I left the camp in charge of Mr. Zietz, the other members of the party being three

assistants, a cook, and two Afghans in charge of five camels. The absence of all feed near the camp rendered it necessary that these latter should have their encampment on the eastern shore, at a distance of about two miles and a half.

The number of the party thenceforth remained unchanged.

Without the camels, which were lent to us by the liberality of the South Australian Government, it would have been quite impossible to carry on the work. By them meat, which sometimes went bad before the day was out, had to be brought a distance of six miles from Callabonna Station, as well as water from the same place, until, with the advance of summer, the station supply fell short, when it became necessary to send to a well at a still greater distance, and every stick of firewood had to be fetched several miles. From the ravages of rabbits, of which there will be more to say directly, it was difficult to keep the camels in sufficiently good condition for their work, and each journey for wood and water generally required two days.

When in the course of a fortnight after the rain, the ground had sufficiently dried to permit of the excavations being resumed, operations were commenced by Mr. Zietz at a place about a mile north-west of the camp from which his predecessor, Mr. Hurst, had obtained a number of bones. The subsequent yield, however, was inconsiderable in quantity, and such as were found were much broken and decomposed. They represented, however, a variety of species, odd bones of large and small Diprotodons, of the giant Wombat (*Phascolomys*), of Kangaroos, and of Birds being mixed together in great confusion; or it might be that the bones apparently of a single Diprotodon, even in previously unopened ground, were widely separated and broken, the fractures being sharp, and the missing pieces not discoverable.

This locality was consequently abandoned in favour of parts nearer the camp; from these good results were continuously obtained, and among them one apparently complete, and one nearly complete Diprotodon skeleton (Fig. 1), which were found in ground that had been tramped over hundreds of times in going to and fro between the camp and the more distant workings. Here also the remains of four birds were found lying close together. It may be mentioned that underground bones were usually discovered by probing with a wire rod, the sense of touch easily detecting the impact even with those that were soft.

Character of Lake Bed.

The Lake bed in the fossiliferous area adjacent to the camp comprises what appears to be one of its most low-lying parts. Its superstratum is a layer of stiff yellowish clay of variable depth, but usually of not less than about a foot in thickness, not of uniform character, but marked by streaks or veins of a rusty colour, containing much fine, sharp sand, due apparently to surface cracks having been filled up with drift-sand. In some places this veining is so irregular and contorted as to give the clay a marbled appearance. On drying, the clay separates readily, along these streaks, into quadrangular or polygonal masses somewhat after the manner of coal.

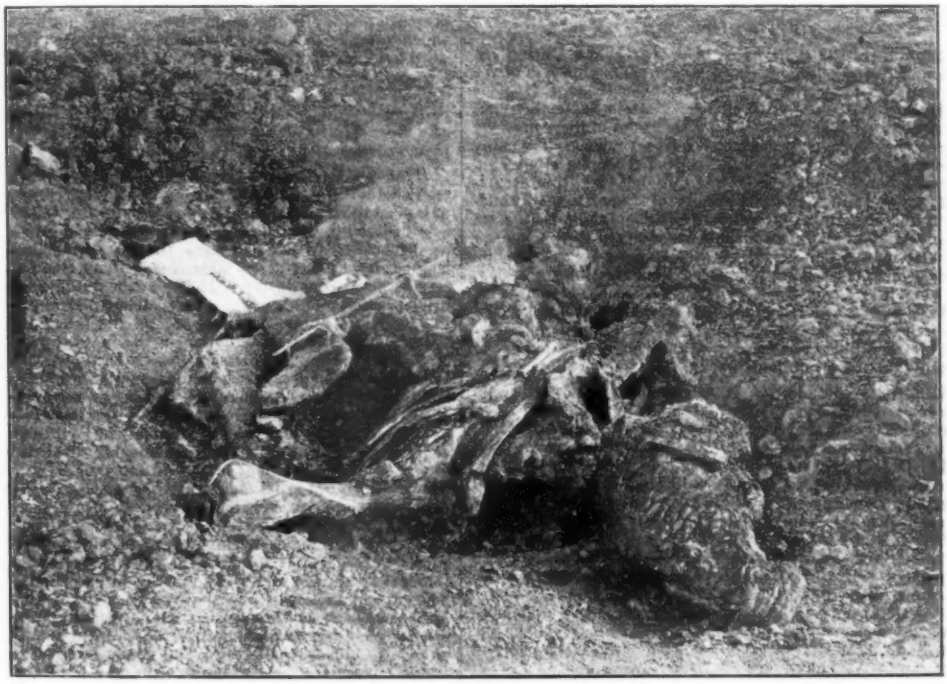

FIG. 1.—Diprotodon skeleton partially excavated.

Beneath this superstratum is a layer of unctuous blue clay, of about two feet in thickness, resting upon a band of coarse sharp sand, beneath which no bones were ever found by Mr. Zietz. Below the sand the same blue clay occurs again for an undetermined depth, and shows in parts a laminated structure, with salt water lying in the interlaminar spaces. The greatest depth actually reached was between six and seven feet.

On physical analysis this clay yielded 15–20 per cent. of fine, sharp quartz-sand, while an approximate chemical analysis, kindly made for me by Mr. Turner, Demonstrator of Chemistry in the University, yielded the following results:—

Water	13 per cent.
Silica	40 ,,
Calcium carbonate	8·5 ,,
Alumina and iron	11·3 ,,
Magnesia	1·5 ,,
Alkaline chlorides and sulphates (mainly sodium sulphate)	25·7 ,,
Total	100·0 ,,

In the dry state numerous minute crystals of sulphate of calcium were visible in the clay.

In the least low-lying parts of the area salt water is reached at from two feet and a half to three feet; in the most depressed it remained permanently on the surface during the whole period of the excavations, which extended over the dry months of August, September, October, and November. In parts which are neither the highest nor the lowest the surface clay remains merely damp, and it was in ground of this character that the bones in best condition were found, provided that the underlying water did not approach the surface too nearly. In such cases, and in the very low places where the water remained permanently on the surface, it was impossible to excavate on account of the excessive inflow into the holes.

(*To be continued.*)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—Sir Henry W. Acland, Bart., and Prof. J. S. Burdon Sanderson have been appointed representatives of the University at the eighth International Congress of Hygiene and Demography, to be held at Buda-Pesth in September.

The Sixth Annual Report of the Delegates of the University Museum has been published, and gives evidence of steadily increasing activity in the scientific work of the University. With increasing activity increased wants are felt, and the Regius Professor of Medicine, the Professor of Experimental Philosophy, and the Hope Professor of Zoology state that extra space is required for particular subjects required to be taught or exhibited in their departments. The reports of the Linacre Professor, and of the Curator of the Pitt Rivers Museum, contain long lists of specimens which have been added by gift, purchase, or exchange to the collections under their care, and one of the most satisfactory features of the report is the statement of the various researches which have been carried out in different laboratories during the past year.

CAMBRIDGE.—In addition to the honorary doctor's degrees to be conferred in connection with the visit of the Royal Agricultural Society to Cambridge, the honorary degree of M.A. will be conferred on June 27 on Mr. Ernest Clarke, secretary, and Dr. J. A. Voelcker, consulting chemist, to the Society.

Mr. A. E. Shipley, of Christ's College, has been appointed University Lecturer in the Advanced Morphology of the Invertebrata for five years from Michaelmas 1894, in the room of Prof. S. J. Hickson.

Mr. S. Ruhemann, of Gonville and Caius College, has been reappointed University Lecturer in Organic Chemistry for five years from Michaelmas 1894.

Mr. J. J. Lister, of St. John's College, has been appointed University Demonstrator of Comparative Anatomy.

At St. John's College the following awards in Natural Science were announced on June 18:—

Foundation Scholarships assigned or continued: W. L. Brown (Physiology); W. McDougall (Physiology and Anatomy); S. S. F. Blackman (Zoology); W. C. Brown, Butler, Orton, and R. J. Horton-Smith (subjects of Natural Sciences Tripos, Part I.); V. H. Blackman, Northcott, Tollent, West (second year subjects); Hemmy, Morgan (first year subjects). Hutchinson Studentship (for research in Pathology): F. Villy. Hughes Prize (third year): S. S. F. Blackman. Wright's Prizes: Tallent (second year), Hemmy (first year). Herschel Prize (for Astronomy), Fearnley.

SCIENTIFIC SERIALS.

The American Meteorological Journal for June contains a summary of an interesting article by Dr. F. Umlauft, on the names of the winds, originally published in the *Deutsche Rundschau für Geographie und Statistik* (vol. xvi. No. 3). The winds are mostly named according to the regions from which they come; thus winds blowing from land to sea are called land-breezes, and *vice versa*. The original names of the east and west points of the compass, and of the winds from those points, were derived from words connected with the appearance and disappearance of daylight; the names of north and south were principally associated with the kinds of weather that came from those points. Other names for the winds are associated with certain definite characteristics. In some places, on lakes, the winds are termed lower or upper winds, according to whether they originate at the lower or upper end of the lake; on the lake of Garda the upper wind is called *Sopero*, from the Italian *Sopra*, on the lake of Geneva; the wind coming down from the Vaud country is known as *Vaudaire;* and in the Rhine valley, the breeze blowing from the Wisp Valley is called *Wisperwind*. The Italians call their north-east wind *Greco*, and the Romans called the south-west wind *Africus*, while the Italians still call it *Affrico*. Homer names four winds only: Boreas, the north wind coming from Northern Greece; Zephyros, the west wind, from the word meaning darkness; Euros, indicating light, means a wind from the east; and Notos, from the word *Notios*, wet, a south wind in Greece. Winds are further named according to their influences and effects for good or evil; in Switzerland and the Tyrol the warm wind which melts the snow is known as *Aperwind;* while *Bise*, *Bis* or *Beiss* are the names given to the cold north wind; and *Maestro*, or master-wind, is the name given to the north-west wind which prevails in summer over the Adriatic; in France the word becomes *Mistral*, and it is a destructive wind. The word *Samoom*, given to the destructive desert wind of Arabia, is derived from the Arabic word *Stim*, poison. For further particulars we refer our readers to the original article, which has also been reprinted in the *Meteorologische Zeitschrift* for January last.

Wiedemann's Annalen der Physik und Chemie, No. 6.—On the radiation of gases, by F. Paschen. The long-wave spectrum of water vapour and the absorption spectrum of liquid water is here dealt with. Rubens's latest re-determinations of the dispersion curve of fluorspar show that all the author's wave-lengths above 2·6 μ, based upon Rubens' and Snow's previous results, are untrustworthy. The author deals fully with Pringsheim's criticism of his work.—On some methods of determining the pitches of high notes, by F. Melde (see p. 155).—On the relation between the lowering of the freezing-point of solutions and their osmotic pressures, by C. Dieterici. The author works out an equation by which the osmotic work may be calculated from the depression of the freezing point, even in cases where the latter amounts to 50° C.—On the absorption of hydrogen by water and aqueous solutions, by Paul Steiner. The coefficients of absorption may be roughly divided into two groups—those of solutions of monad salts, of K, Li, and Na, and those of dyad salts, such as K_2CO_3, $CaCl_2$, Na_2SO_4. The curves exhibiting the relation between absorption and concentration form two bunches for the two groups. The curve for sugar solution is approximately a straight line, intersecting the curves of the second group.—On the electric conductivity of some salts dissolved in ethyl and methyl alcohol, by B. Völlmer. The molecular conductivities of the electrolytes tested in the alcohol increase as the concentration decreases. With extreme dilution they approach a limiting value, except those of $CaCl_2$ and CaN_2O_6 in ethyl alcohol. The conductivity also decreases as the molecular weight of the solvent increases.—On the similarity of the light emitted by an after-glowing Geissler tube and the beginning of the glow of solid bodies, by Carl Kirn. The spectrum of the after-glow contracted into a space between the wave-lengths of 555 and 495 $\mu\mu$, and appeared greyish-yellow. This is in accordance with Weber's observation, who noticed that a solid does not begin to glow red, but that the first colour to appear is a greenish-yellow band in the region of maximum luminosity of the solar spectrum.—On the electric and magnetic forces of the atoms, by F. Richarz.—On the forms of motion upon which electromagnetic phenomena may be based, by Hermann Ebert.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 24.—"On the Measurement of the Magnetic Properties of Iron." By Thomas Gray, Professor of Dynamic Engineering, The Rose Polytechnic Institute, Terre Haute, Indiana.

This paper gives the results of a continuation of the investigation which formed the subject of a paper communicated to the Royal Society in 1892, and published in the *Philosophical Transactions*, vol. clxxxiv. A. pp. 531–542. The results now given

have been to a large extent obtained by the same method, namely, from the curves giving the relation of the current flowing in the circuit to the time measured from the application or the reversal of the impressed E.M.F. on the circuit. In this case, however, the personal element has been eliminated from the curves by the application of the autographic recorder referred to as under construction in the previous paper. This apparatus, which is a modification of the "Thomson siphon-recorder," has been found to work satisfactorily, and has considerably increased the ease and the accuracy with which the curves can be produced. A description of the apparatus and specimens of the curves drawn by it are included in the paper. There is also included in the paper a description of the apparatus and method of experiment in the application of a watt-meter to the determination of the energy dissipated by transformers under E.M.F.'s of different frequency of alternation. The accuracy of the measurements so made were checked by comparison with the results of measurements made by Joubert's instantaneous contact method. The apparatus and method of experiment adopted for the application of this method were to some extent different from those commonly employed, and they are therefore described.

The results of some further experiments on the large electro-magnet used in the previous experiments, and described in the paper above referred to, are given, but a large part of the results quoted in this paper refer to closed circuit transformers of the types manufactured by the Westinghouse and the Genera Electric Companies. The experiments have been chiefly directed to the following points:—

(1) *A Comparison of the Total Energy required to produce Different Magnetic Inductions, and the Corresponding Dissipation of Energy.*—In connection with this, the effect of air gap in the magnetic circuit has been investigated somewhat more fully. It is shown that, by introducing a moderate air gap, the energy dissipated for a given induction through the coils may be reduced one-third.

(2) *The Law of Variation of Hysteresis with Variation of Induction.*—The experiments indicate that, although for any special case the energy dissipated can be approximately expressed by an equation of the form $E = AB^{\alpha}$, that both A and α are different for different kinds of iron. It seems probable, also, from the results obtained, that α is not absolutely constant for any one iron, but that it increases with increase of B.

(3) *The Effect of Increased Frequency of Cyclic Variation of Magnetism on the Dissipation of Energy.*—In this investigation a transformer, the iron case of which was made up of very thin sheets, was used. The thickness of the sheets was about 16-100ths of a millimetre, and the sheets were insulated from each other by means of thin paper. The full load capacity of the transformer was about 6000 watts. The range of frequency (including the autographic recorder, the wattmeter and the Joubert's instantaneous contact method experiments) was about from 3 per minute to 8000 per minute. The results indicated that, throughout this range, there is no variation in the dissipation of energy per cycle when the inductions are equal.

Data deduced from these experiments as to the magnetic qualities of the iron used in the different transformers is given in the paper.

Zoological Society, June 5.—Sir W. H. Flower, K.C.B., F.R.S., President, in the chair.—The Secretary read a report on the additions that had been made to the society's menagerie during the month of May.—Mr. Sclater made some remarks on the chief animals that he had observed during a recent visit to the Zoological Gardens of Rotterdam, Amsterdam, Hanover, Berlin, and Hamburg.—A communication was read from Dr. E. A. Goeldi, containing critical remarks on the opossums of the Serra dos Orgãos, Rio de Janeiro, Brazil.—Mr. O. Thomas gave an account of the gazelles of Algeria, chiefly based on specimens brought home by Sir Edmund Loder, and distinguished three unquestionable species, *Gazella dorcas*, *G. cuvieri*, and *G. loderi*, the last being a new species of which examples had been obtained by Sir Edmund Loder in the sand-hills three days south of Biskra. A fourth gazelle, of which a skin and skull had been bought by Sir Edmund Loder in Algiers many years ago, was referred with some doubt to *Gazella corinna*, the Corinne of Buffon.—Sir Edmund Loder then gave an account of his expedition in search of the "Reem," as the *Gazella loderi* is called by the Arabs, and stated what he had learnt of its habits and distribution.—A second communication from Sir Edmund Loder contained remarks on the period of gestation of the Indian antelope, as observed in captivity.—A communication was read from Dr. W. B. Benham, containing notes on a particularly abnormal vertebral column of the bull-frog (*Rana mugiens*), and on certain other variations in the anurous column of this frog.—Mr. Lindsay Johnson read a communication on the pupils of the felidæ, and stated that, after an examination of the eyes of 180 domestic cats, as well as the eyes of all the felidæ in the society's gardens, he had come to the conclusion that the natural shape of the pupil in *Felis* is circular. Although under various degrees of light one might get every shape from the circle through all degrees of oval to a perfectly vertical line, yet instillations of atropine or cocaine solutions caused every pupil to become a true circle. The younger the cat the greater the tendency for the pupil to become pointed oval in ordinary light, and, conversely, the older the cat the more frequently did we find a circular pupil. Brilliant light always caused contraction to oval, and direct sunlight to a thin line in the smaller felidæ; in the larger felidæ Mr. Johnson had frequently found the pupils contract to a small circle. Suddenly alarming a cat had the effect of momentarily dilating the pupil; while in sleep the pupil was always contracted. The communication was illustrated by models and diagrams.

Entomological Society, June 6.—Henry John Elwes, President, in the chair.—Mr. W. F. H. Blandford exhibited a series of eleven male specimens of *Rhina barbirostris* from British Honduras, of which the largest and smallest examples measure respectively 60 and 17 mm. The difference in bulk, supposing the proportions to be identical, is as 43 to 1. He remarked that this variation of the size is especially common in the *Brenthidæ*, *Cossonidæ*, and other wood-boring Coleoptera. The President, Dr. Sharp, F.R.S., the Rev. Canon Fowler, Mr. Jacoby, the Hon. Walter Rothschild, Mr. Merrifield, and Mr. Champion took part in the discussion which ensued.—Mr. A. J. Chitty exhibited specimens of *Cardiophorus equiseti* taken near Braunton, on the north coast of Devon, in May 1891. Mr. Champion and Mr. Blandford made some remarks on the species.—Mr. McLachlan, F.R.S., exhibited for Mr. J. W. Douglas male specimens of a Coccid (*Lecanium prunastri*), bred from scales attached to shoots of blackthorn (*Prunus spinosa*) received from Herr Karel Sulç, of Prague. Mr. Douglas communicated notes on the subject, in which he stated that the species was common on blackthorn in Germany, and should be found in Britain.—Lord Walsingham, F.R.S., exhibited a series of *Cacacia podana*, Scop., reared from larvæ feeding on *Lapageria* and palms in Messrs. Veitch's conservatories in King's Road, Chelsea, including some very dark varieties. The Hon. Walter Rothschild stated that he had taken the species on lime. Mr. Hampson and Mr. Tutt also made some remarks on the habits of the species.—Mr. C. Fenn exhibited a long series of *Selenia lunaria*, bred from one batch of eggs, which included both the spring and summer forms; and also two unforced specimens, which emerged in November. He remarked that the variation between the two emergences, viz., spring and summer, is considerable, and also the range of variation *inter se*, especially in the spring form; but it is very remarkable that the summer form has one or two representatives among the specimens of the spring emergence. He said that the parent female was taken at Bexley in May 1893.—Mr. F. Lovell-Keays exhibited a variety of *L. alexis* (female), having the marginal ocelli on the hind wings entirely without the usual orange-coloured lunules. The specimen was captured at Caterham on May 22, 1894, and was the first example of the species observed by the captor this season. Mr. Barrett made some remarks on the specimen.—Mr. J. H. Durrant exhibited a series of *Steganoptycha pygmæana*, Hb., taken at Merton, Norfolk, between March 25 and the middle of April last. Lord Walsingham made some remarks on the species.—Mr. H. Goss read an extract from a report from Mr. J. R. Preece, her Majesty's consul at Ispahan, to the Foreign Office, on the subject of damage caused to the wheat crop in the district of Rafsinjan by an insect which was called "Sen" by the natives, and which he described as "like a flying bug, reddish-olive in colour, with heavy broad shoulders." Mr. Goss said he had been asked by Mr. W. H. Preece, F.R.S., to ascertain, if possible, the name of the species known to the natives as "Sen." Dr. Sharp said that in the absence of a specimen of the insect it was impossible to express an opinion as to the identity of the species.—The Rev. Canon Fowler

exhibited for Miss Omerod specimens of *Diloboderus abderus*, Sturm, *Eucranium arachnoides*, Brull., and *Megathopa violacea*, Blanch., which she had received from the La Plata district of the Argentine territories, where they were said to be damaging the grass crops. He also read notes from Miss Ormerod on the subject.—Mr. Hampson raised an important point as to what was the legal "date of publication" of part i. of the *Transactions* of the Society, 1894. He pointed out that the question of the priority of the names of certain new species described therein would depend upon the date of publication. A long discussion then ensued, in which Dr. Sharp, the Hon. W. Rothschild, Mr. Goss, Mr. McLachlan, Lord Walsingham, Prof. Poulton, F.R.S., and Mr. Verrall took part.—Prof. Franz Klapálek, of Prague, communicated a paper entitled "descriptions of a new species of *Raphidia*, L., and of three new species of Trichoptera from the Balkan Peninsula, with critical remarks on *Panorpa gibberosa*, McLach."—Lord Walsingham, ex-President and Vice-President, then took the chair, and a special general meeting convened under chap. xviii. of the bye-laws was held.

Geological Society, June 6.—Dr. Henry Woodward, F.R.S., President, in the chair.—On the banded structure of some tertiary gabbros in the Isle of Skye, by Sir Archibald Geikie, F.R.S., and J. J. H. Teall, F.R.S. After calling attention to the previous references to the pseudo-bedding and banding of the gabbro masses of the Inner Hebrides, the authors described the rocks which form the rugged ridge of Druim-an-Eidhne, near the head of Glen Sligachan. This ridge is made up of parallel beds, sheets, or sills disposed in a general N.N.W. direction with a prevalent easterly dip. Four distinct types of gabbro occur: (1) dark, fine-grained, granulitic gabbros; (2) well-banded gabbros; (3) coarse grained massive gabbros; and (4) pale veins of a highly felspathic gabbro. The relative ages of the banded and granulitic gabbros have not been definitely settled; but the coarse, massive gabbros are certainly intrusive in the banded series, and the pale veins cut all the other varieties. The authors dealt mainly with the banded gabbros. These occur in successive sheets or sills which vary from a few feet to many yards in thickness, and consist of parallel layers of lighter and darker material which correspond in direction with the trend of the sheets, and are usually inclined to the east or south-east at angles ranging from 20° to 30°. In some cases the bands can be seen to have been puckered or folded. The minerals entering into the composition of the banded, as also of the other varieties, are labradorite, pyroxene, olivine, and titaniferous magnetite. The banding is due to a variation in the relative proportions of the different constituents, and especially in the amount of magnetite. Some narrow bands and lenticles are composed entirely of pyroxene and magnetite. The variations in chemical composition were illustrated by three analyses by Mr. Player. The microscopic characters of the rocks were described, and it was shown that the minerals of the banded gabbros have not been crushed or broken since they were formed. The authors concluded that the banding is the result of the intrusion of a heterogeneous magma, and that similar banding in certain portions of the Lewisian gneiss may have been produced in the same way. Dr. Johnston-Lavis, Prof. Blake, Dr. Hicks, Mr. Harker, and Mr. J. Hort Player spoke upon the subject of the paper, and Sir Archibald Geikie briefly replied.—On the microscopical structure of the Derbyshire carboniferous dolerites and tuffs, by H. H. Arnold-Bemrose. This paper dealt with the petrography of the toadstones or igneous rocks of Derbyshire. Brief reference was made to the work of previous petrographers, the age of the rocks, and the question as to the number of beds. The outcrops mapped by the geological survey, and several additional ones, have been examined, and the results were given in a table for the purpose of the paper and for future reference. The toadstone was divided into massive rocks or lavas, and fragmental rocks or tuffs. The former consist of olivine-dolerite, either with granular or with ophitic augite, and olivine-basalt. The rock is often very fresh, but in some places is altered to a diabase. The principal constituent minerals were described. A pseudomorph of olivine, optically like biotite and somewhat like Iddingsite, but differing from it chemically, was fully described. A discussion followed, in which Sir Archibald Geikie, Mr. W. W. Watts, and Dr. Johnston-Lavis took part.—On the origin of the Permian breccias of the Midlands, and a comparison of them with the upper carboniferous glacial deposits of India and Australia, by R. D. Oldham. The author first described the Permian breccias of the Midland counties of England, which he had the opportunity of examining at Eastertide of the present year. He described the characters of the breccias, and concluded that they were formed subaërially as gravel-fans by rivers charged with a maximum load of sediment, and therefore incapable of performing any appreciable amount of erosion. An examination of many of the fragments at Abberley and some at Church Hill revealed the presence of scratches, which occur in such a manner that the author believed they existed on the fragments before they were transported, and discussed the evidence for their production by ice or soil-cap movement, deciding in favour of the former. A short description of the upper carboniferous deposits of India followed, and it was pointed out that they differ markedly from the deposits of Britain. Amongst other things the separation of different pebbles by considerable interspace of matrix, and the bending of stratification-planes round a pebble as though the pebble had dropped from above, was noted, and it was maintained that floating ice alone will account for these pebbles being dropped into the Indian deposits. Finally, it was remarked that the so-called upper carboniferous deposits of India and the Permian deposits of the Midlands of Britain may be practically contemporaneous, as maintained by the late Mr. H. F. Blanford, indicating a possible simultaneous existence of glaciers in England, India, and Australia. Prof. Lapworth made some remarks upon the paper, and the author replied.

Linnean Society, June 7.—Mr. C. B. Clarke, F.R.S., President, in the chair.—The President nominated as Vice-Presidents for the year Messrs. J. G. Baker, W. Carruthers, F. Crisp and Prof. C. Stewart.—Dr. John Lowe communicated the results of observations made by him in Madeira and Teneriffe on the habit in certain insectivorous small birds belonging to the genera *Sylvia*, *Phylloscopus* and *Parus* (of which specimens were exhibited) of puncturing the calyces of flowers for the purpose of attracting insects on which they feed. An interesting discussion followed, in which the President, the Rev. G. Henslow, and others took part—Mr. Carruthers exhibited a series of photographs of the celebrated Cowthorpe Oak in Yorkshire, taken at long intervals, commencing with a reproduction of Dr. Hunter's engraving of 1776, and made remarks upon the rate of growth and decay, and probable duration of life in this tree.—Mr. Raymund Dowling exhibited and made remarks upon a dwarf glaucous pine, and some curiously shaped *Trapa* fruits from Japan.—Mr. Thomas Christy exhibited specimens of two species of *Polygonum* (*P. sachalinense* and *P. cuspidatum*), of value for forage, and pointed out that the roots of the mature plants, when cut, are, in the former species, of a whitish colour, and in the latter of a bright yellow, enabling the two to be readily distinguished apart from the leaves.—A paper was then read by the Right Hon. Sir John Lubbock, Bart., M.P., F.R.S., on stipules and the protection of buds. A discussion followed, in which the Rev. G. Henslow, Mr. A. W. Bennett, Prof. Marshall Ward, and Mr. John Fraser took part.—Before the meeting adjourned, the President announced that a bust of Charles Waterton, the Yorkshire naturalist, and author of "Wanderings in South America," had been presented to the Society by the trustees of the late Mrs. Pitt Byrne (*née* Busk). This bust was executed in 1865 (the year in which he died, at the age of eighty-three) by the late Mr. Waterhouse Hawkins; it is an excellent likeness, and the only bust of him in existence. The only accessible portrait of him is a small engraving by Adlard, which forms a frontispiece to the third volume of the "Essays on Natural History," from an original oil painting by Charles W. Peale, made in Philadelphia in 1824, when Waterton was in his forty-second year.

CAMBRIDGE.

Philosophical Society, May 28.—Prof. T. McKenny Hughes, President, in the chair.—The announcement was made that the adjudicators of the Hopkins prize for the period 1889–91 have awarded the prize to Prof. J. J. Thomson, F.R.S., for his researches on electrical oscillations and other important contributions to electrical theory.—Mr. Warburton exhibited specimens of the nest of *Trochosa picta*, a Lycosid spider found in abundance on the sand-hills of Southport. The nest is not so simple as was supposed, as it possesses a pouch or off-shoot from the main burrow directed upwards and forwards. In this the spider takes refuge when disturbed.

There are two well-marked varieties of this species, the one being pale and light-coloured, and inhabiting the sandhills of Poole in Dorsetshire and Southport in Lancashire, while the dark variety occurs in various localities on dark peaty soil.—Mr. S. Skinner exhibited specimens of magnetic rock. The fragments of rock shown were from the Riffelhorn, near Zermatt, a mass of rock which appears to be permanently magnetised in a direction E.—W. with north polar magnetism towards the west. They are composed of serpentine with small veins of magnetic oxide of iron. The magnetic fields of these fragments have been mapped with a small compass needle and show both regular poles and consequent poles. It is suggested that the magnetism preserved in these fragments was due to magnetic forces acting at the time of the formation of the veins of magnetic ore. With certain assumptions, it follows that these forces acted almost at right angles to the present direction of the magnetic meridian, a conclusion possibly consistent with our present knowledge of the secular variation.—Mr. A. C. Dixon read a paper on a "Geometrical proof of a Theorem of Convergency."

DUBLIN.

Royal Dublin Society, April 18.—The Earl of Rosse in the chair.—Dr. G. Johnstone Stoney, F.R.S., communicated a paper on a mounting for the specula of reflecting telescopes, designed to remove the impediment to their being used for celestial photography. The author observed that reflecting telescopes are much cheaper than refractors; moreover, their uniting rays of all refrangibilities in one focus would give them an immense advantage over refractors for photographing the heavens and in celestial spectroscopy, were it not for the difficulty of keeping their line of collimation sufficiently fixed. This difficulty arises from the necessity of supporting the speculum by a very equable pressure applied over its whole back. The mechanical appliances for securing this must be so delicate that they yield a little when the telescope is moved from one altitude to another. The author of the present communication proposes to get rid of this imperfection by substituting compressed air for the "bed of levers" or layers of flannel which have hitherto been employed, and he describes a regulator through the intervention of which the pressure will vary automatically according to the requisite law when the telescope is moved from one altitude to another. With this contrivance the speculum is made the front of a closed chamber, and rigidly maintains its position with reference to it, and therefore with reference to the tube of the telescope, however the latter may be moved about.—Sir Howard Grubb, F.R.S., read (*a*) a note on the effect of tarnish on the transmission of light through telescopic objectives; (*b*) a note on the construction of an equatorial with complete circumpolar motion.—Prof. W. Noel Hartley, F.R.S., exhibited photographic enlargements of band spectra of metals, and Bessemer flame spectra, and gave a description of these phenomena.—At the meeting held May 16, Mr. Albert Taylor read a paper (communicated by Sir Howard Grubb, F.R.S.) on the photographing of the solar corona during total solar eclipses (with special reference to the author's experiences at the Brazilian station at Para Curu, during the total solar eclipse of April 1893), and on the selection of suitable instruments. The author commented upon the results obtained at the various stations at which the eclipse of 1893 was observed, and suggested that the organisation of expeditions to observe the next total solar eclipse (August 8, 1896) should at once be begun.—Mr. A. F. Dixon exhibited models constructed from microscopic sections by a method first used by Prof. His. The sections are drawn by means of a camera lucida, on glass plates covered with negative varnish, and the model is completed by simply placing the plates in order one over the other. This method is found especially useful in tracing the courses and connections of fine nerves in the embryo.

PARIS.

Academy of Sciences, June 11.—M. Lœwy in the chair.—Note on the great coudé equatorial of the Paris observatory, by M. Lœwy.—The green substance of Phyllum Orthoptera of the family of the Phasmidæ, by MM. Henri Becquerel and Charles Brongniart. A spectroscopic examination has determined the identity of this substance with chlorophyll.—On the homologues of quinine; their physiological and therapeutic action, by MM. E. Grimaux, Laborde, and Bourru. The substances cupreine, methyl cupreine (quinine), ethyl cupreine, propyl cupreine, and amyl cupreine have been studied. As the molecular weight increases the toxic dose becomes rapidly smaller, and the therapeutic action becomes more vigorous. The ethyl derivative should be used as an antiperiodic when quinine has failed, and the propyl derivative might perhaps be employed as a powerful antithermic in cases of continued fevers.—Observations of the planets AV (Courty, February 11, 1894), AZ (Courty, March 5, 1894), and of Denning's comet (March 26, 1894), made at Bordeaux by MM. G. Rayet, L. Picart, and F. Courty: note by M. G. Rayet.—Discovery of Champsosaurians in beds of phosphorite in the Algerian suessonian, by M. A. Pomel.—On the chromosphere of the sun. A reply to the last note of M. Hale, by M. H. Deslandres.—A new application for bichromated gelatine, by M. Izarn. The material is proposed to be used for the protection of silver surfaces on instruments, backs of mirrors, and so forth. It has given good results in trial cases.—On an application of continued fractions, by M. Stieltjes.—On the algebraical integrals of linear differential equations of the second order, by M. P. Vernier.—On equations of derived partials of the second order, by M. X. Stouff.—On magnetisation produced by Hertzian currents; a magnetic dielectric, by M. Birkeland.—On the nature of electric conductibility, by M. Vaschy.—Measurement and comparison of coefficients of self-induction by alternating currents of great frequency, by M. H. Abraham.—On the mean geometric distance of the elements of a group of surfaces and its application to the calculation of coefficients of induction, by M. Ch. Eug. Guye.—On the estimation of iodine, by MM. A. Villiers and M. Fayolle. The iodine is liberated by means of ferric chloride, taken up by carbon bisulphide, and titrated in the separated solution by standard sodium thiosulphate.—On the acid sulphates of aniline and ortho- and paratoluidine, by M. Edmond Hitzel.—The synthesis of hexamethylene derivatives; triethylphloroglucinol, by M. A. Combes.—A note on the qualitative composition of officinal creosotes from oak and beech woods, by MM. A. Béhal and E. Choay.—Action of primary aromatic bases on dissymmetrical ketonic compounds, by M. L. Simon. The work was undertaken with the object of discovering in aniline derivatives of the form $\begin{matrix} R.C.R' \\ \| \\ N.C_6H_5 \end{matrix}$ indications of an isomerism analogous to that obtaining among oximes. The condensations quoted in the communication were effected in the cold and in the absence of every condensing reagent capable of producing migrations. Isomerism has not been observed in any case.—On the stability of aqueous solutions of mercury bichloride, by M. E. Burcker. The author concludes that (1) ordinary waters cause the immediate decomposition of mercury bichloride, and this action continues under the combined influence of air, light, and the substances contained in the water or brought by the air; (2) the decomposition becomes insignificant when the solution is removed from the influence of air and light; (3) solutions made with distilled water undergo very little change, even when exposed to air and light.—On the preparation of tetrachlorethylene and the action of ozonised oxygen on this body, by M. A. Besson.—On a ptomaine extracted from the urine of cancer patients, by M. A. B. Griffiths. This substance has the composition $C_8H_5NO_3$, and is termed *cancerine*. It is a very poisonous base, giving alkaloid reactions and crystallising in microscopic needles. It is alkaline and soluble in water.—Researches on the internal ear of the "Roussette de l'Inde" (*Pteropus medius*), by M. Beauregard.—On the characteristics and the evolution of Lomisinés, a new group of anomurous crustacea by M. E. L. Bouvier.—On the development and formation of excretory canals in *Cerebratula echinata*, by M. Joannes Chatin.—Diptera parasitic on Acridians: oviparous Muscidæ *à larves oophages*. Burrowing Diptera. By M. J. Künckel d'Herculais.—Intercellular communications in lichens, by M. Georges Poirault.—On the geological lines in the neighbourhood of the observatory of Abbadia (Basses-Pyrénées), by M. P. W. Stuart-Menteath.—Defence against Phylloxera, by M. Rabourdin.

BERLIN.

Meteorological Society, May 1.—Prof. Hellmann, President, in the chair.—Dr. Süring gave an account of a winter sojourn, from December to March, on the Brocken. During the three months he experienced several anticyclones, two periods of storm, and several of complete envelopment in clouds,

all of which he described in detail, and then dealt briefly with a whole series of isolated observations made at a height of 1140 m., that is, at the level of the lower clouds. The phenomena touched upon were the formation of rime, force of the wind, sequence of depressions, and maxima of pressure, &c. The outcome of his remarks showed the necessity for a properly equipped station on the Brocken, under expert management. One point of interest may be mentioned, namely that on the Brocken, during an anticyclone the lowest temperature was always observed at the beginning, followed by a rise of temperature in the second half of the period, whereas, as is well known, on the plains the temperature continues to fall right to the very end of the anticyclone.

Physical Society, May 4.—Prof. du Bois Reymond, President, in the chair.—Dr. Pringsheim alluded in appropriate terms to the death in Brooklyn of their foreign member Dr. F. Schulze-Berge.—Prof. König spoke on the number of distinct differences of colour and brightness which can be discriminated in the spectrum. He had made experiments in conjunction with Prof. Dieterici, subsequently verified by Prof. Uhthof, on the mean error existing when matching two tints, and from this he had been able to deduce the total number of differences in tint which a normal trichromatic eye can discriminate from the red to the blue end of the spectrum. Sensitiveness to difference of tint showed two maxima, one in the yellow and one in the greenish-blue, and the total number of distinct differences discriminated was 165. A dichromatic eye, on the other hand, can only discriminate 140 differences. Experiments of the speaker and of Dr. Brodhun formed the basis for determining the number of differences of brightness which can be discriminated, starting with liminal light and increasing it up to a blinding intensity. For both the tri- and di-chromatic eye the number was found to be 650. If it be desired to deduce from the above data the total number of possible visual differences which can be discriminated in a spectrum, it must be remembered that as the intensity of light diminishes, so also does the number of discriminated tints, so that the result is in round numbers $80 \times 700 = 56{,}000$. In connection with the above, Prof. von Bezold suggested that by using complementary colours it may be possible to discriminate a much larger number of tints, since, as is well known, two colours which are indistinguishable when compared directly often give quite different complementary colours, and can thus be distinguished.

Physiological Society, May 11.—Prof. du Bois Reymond, President, in the chair.—Dr. Max Verworn spoke on the polar excitation of cells by galvanic currents. Unicellular freshwater infusoria (Paramœcium) were experimented on, and showed always, on making a constant current, cathodic galvanotropism; by this is meant that all the infusoria in a drop of water placed themselves with their anterior end towards the cathode. They then moved towards and congregated at the cathode. When the direction of the current is reversed the infusoria turn round and move away towards the new cathode. When strong currents are employed it is found that the hinder end of the organism is contracted, and if the stimulation is prolonged the protoplasm is disintegrated. From this the speaker drew the conclusion that the infusoria are anodically excitable, and that the cathodic galvanotropism is due to anodic stimulation. The exact reverse holds good for Opalina, since they are cathodically excitable and anodically galvanotropic. A third group of infusoria (Spirostomum) is transversely galvanotropic.—Dr. Lilienfeld gave an account of his researches on the clotting of blood. He had succeeded in separating Al. Schmidt's fibrinogen into two substances, "thrombosin" and an albumose. The former unites with calcium and forms fibrin, while the albumose retards clotting. The separation of fibrinogen into these two constituents may be brought about by means of acetic acid, nuclein, nucleic acid, and other substances. Blood-clotting accordingly consists in a disintegration of leucocytes setting free nuclein; the latter then decomposes the fibrinogen, and enables the thrombosin to unite with the calcium salts of the blood. While the blood is circulating in the body it contains no free nuclein in solution, and hence clotting is impossible. The speaker further considered that peptones (albumose) and leech-extract prevent clotting by themselves uniting with the calcium of the blood, and thus preventing its union with thrombosin.

Note.—In the report of the meeting of the Meteorological Society for April 3 (NATURE, vol. l. p. 95), for Rassner read Kassner, and for Hasen read Hazen.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—A Pocket Flora of Edinburgh: C. O. Sonntag (Williams and Norgate).—Proof Spirit and Fiscal Hydrometry: Dr. B. Dyerham (J. Heywood).—A Handbook to the Study of Natural History: edited by Lady I. Margesson (Phil.p).—Coloured Vade-Mecum to the Alpine Flora: L. and C. Schröter, 4th edition (Nutt).—Grundzüge der Geometrie: Prof. G. Veronese (Leipzig, Teubner).—Catalogue of Scientific Papers (1874–1883) compiled by the Royal Society of London, Vol. x. (C. J. Clay).—Epitome of the Synthetic Philosophy: F. H. Collins, 3rd edition (Williams and Norgate).—Report of the Meteorological Service of Canada for the Year ending December 31, 1889 (Ottawa).—Zur Fossilen Flora der Polarländer: A. G. Nathorst (Stockholm, Norstedt).—Elementi di Fisica: Prof. A. Roiti, Vol. Primo (Firenze, Monnier).—Zeit-und Streitfragender Biologie: Prof. O. Hertwig, Heft 1 (Jena, Fischer).—Synopsis der Hoeheren Mathematik: J. G. Hagen, Zweiter Band (Berlin, Dames).—Les Oscillations Électriques: H. Poincaré (Paris, Carré).—Geological Sketch Map of Western Australia: H. P. Woodward (Philip).—A Dictionary of Medicine: edited by Sir R. Quain, &c., 2 Vols., new edition (Longmans).—The Physiology of the Carbohydrates: Dr. F. W. Pavy (Churchill).

PAMPHLETS.—Protection from Lightning: A. McAdie (Washington).—The Yellowstone Park: A. Hague (Washington).—Leitneria Floridana: W. Trelease (St. Louis).—Weitere Lichtelectrische Versuche: J. Elster and H. Geitel (Leipzig, Barth).—Report of Mr. Tebbutt's Observatory, the Peninsula, Windsor, N.S.W., for the Year 1893: J. Tebbutt (Sydney).

SERIALS.—Journal of the Chemical Society, June (Gurney and Jackson).—Transactions of the Academy of Science of St. Louis, Vol. vi. No. 15 (St. Louis).—Journal of the Franklin Institute, June (Philadelphia).—Astronomy and Astro-Physics, June (Wesley).—American Naturalist, June (Wesley).—Engineering Magazine, June (Tucker).—Bulletins de la Société d'Anthropologie de Paris, Mars (Paris).—Quarterly Journal of Microscopical Science, June (Churchill).—Intles. Archiv für Ethnographie, Band vii. Heft 3 (Leiden, Brill).—Journal of the Institution of Electrical Engineers, No. 112, Vol. xxiii. (Spon).—Bulletin de la Société Impériale des Naturalistes de Moscou, 1894, No. 1 (Moscou).—Royal Natural History. Part 8 (Warre).—Zeitschrift für Physikalische Chemie, xiv. Band, 2 Heft (Leipzig, Engelmann).—L'Anthropologie, tome v. No. 3 (Paris, Masson).—Field and Garden Crops of the North-West Provinces and Oudh: J. F. Duthie Part 3 (Roorkee).

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